

# POPULAR SCIENCE

MONTHLY

JUNE 1947  
25 CENTS



**The War Against Hail**

p. 82





## LEAK PROOFS

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Ray-O-Vac LEAK PROOFS keep your flashlight *safe* from corrosion—they're insulated and sealed-in-steel to keep corrosive battery materials from damaging your flashlight. This same patented construction prevents loss of battery energy. LEAK PROOFS *stay fresh* 'til you need them! For FREE helpful "Flashlight Service Guide" write Dept. PS-3, Ray-O-Vac Co., Madison 3, Wis.

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Present Occupation \_\_\_\_\_

**EDUCATION:**

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College (*circle years completed*) 1 2 3 4 5 6

Correspondence Schools (*list courses completed*)

\_\_\_\_\_  
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JUNE 1947 |



# POPULAR SCIENCE

Mechanics & Handicraft MONTHLY  
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JUNE 1947

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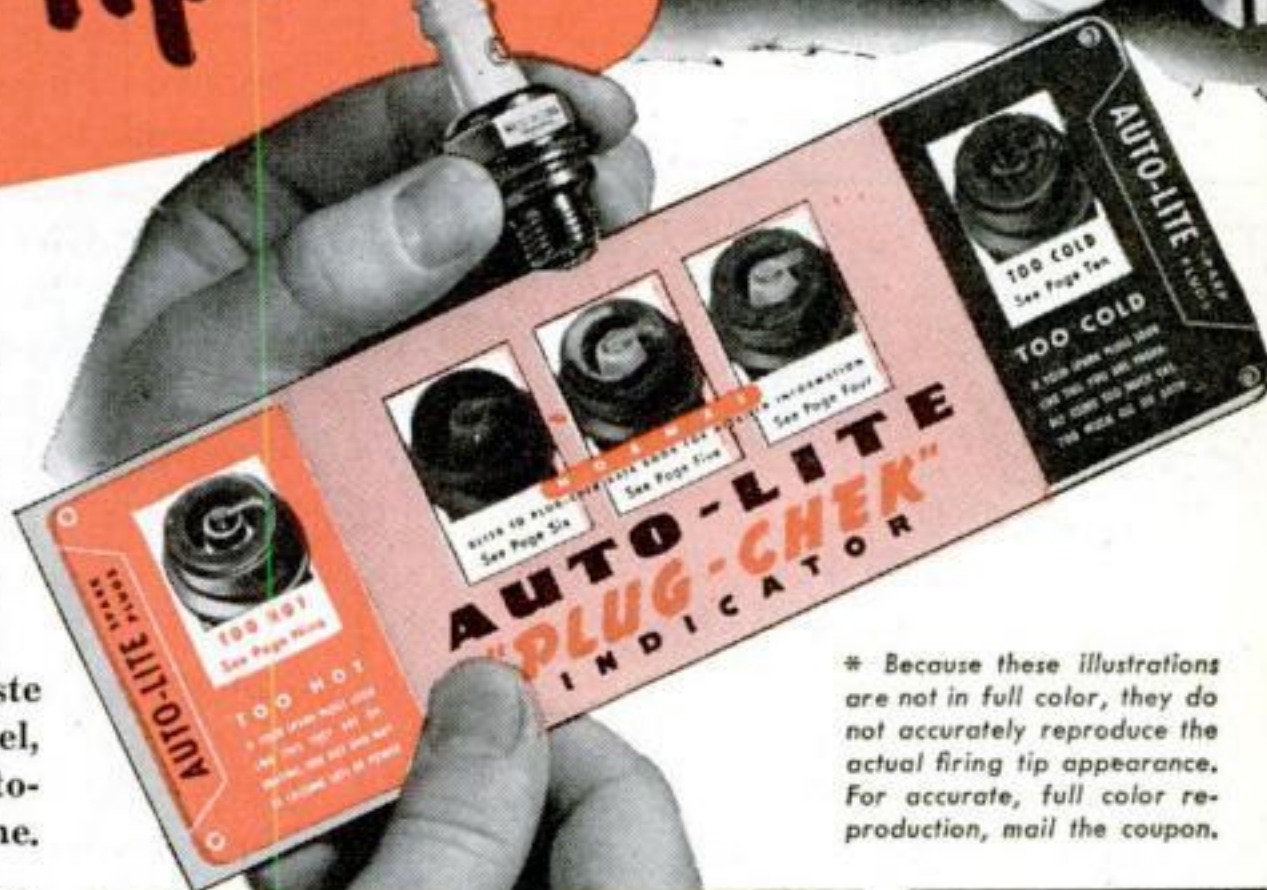


## AVOID WASTE, Check Spark Plugs Regularly

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\* Because these illustrations are not in full color, they do not accurately reproduce the actual firing tip appearance. For accurate, full color reproduction, mail the coupon.



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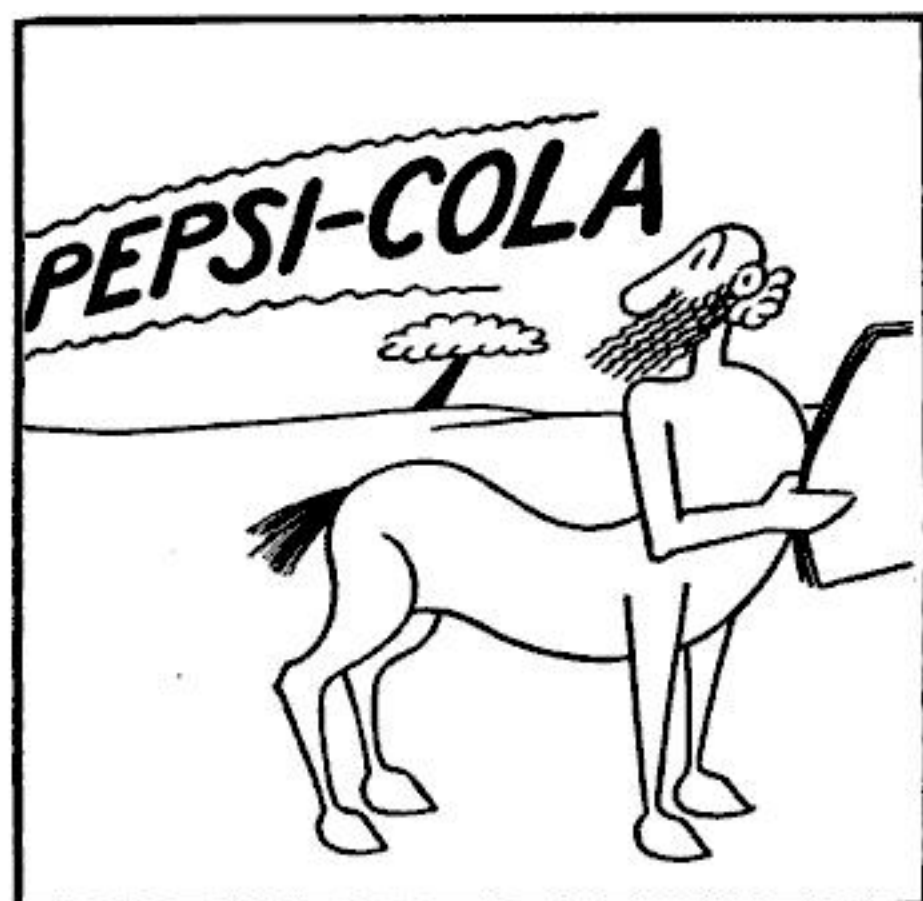
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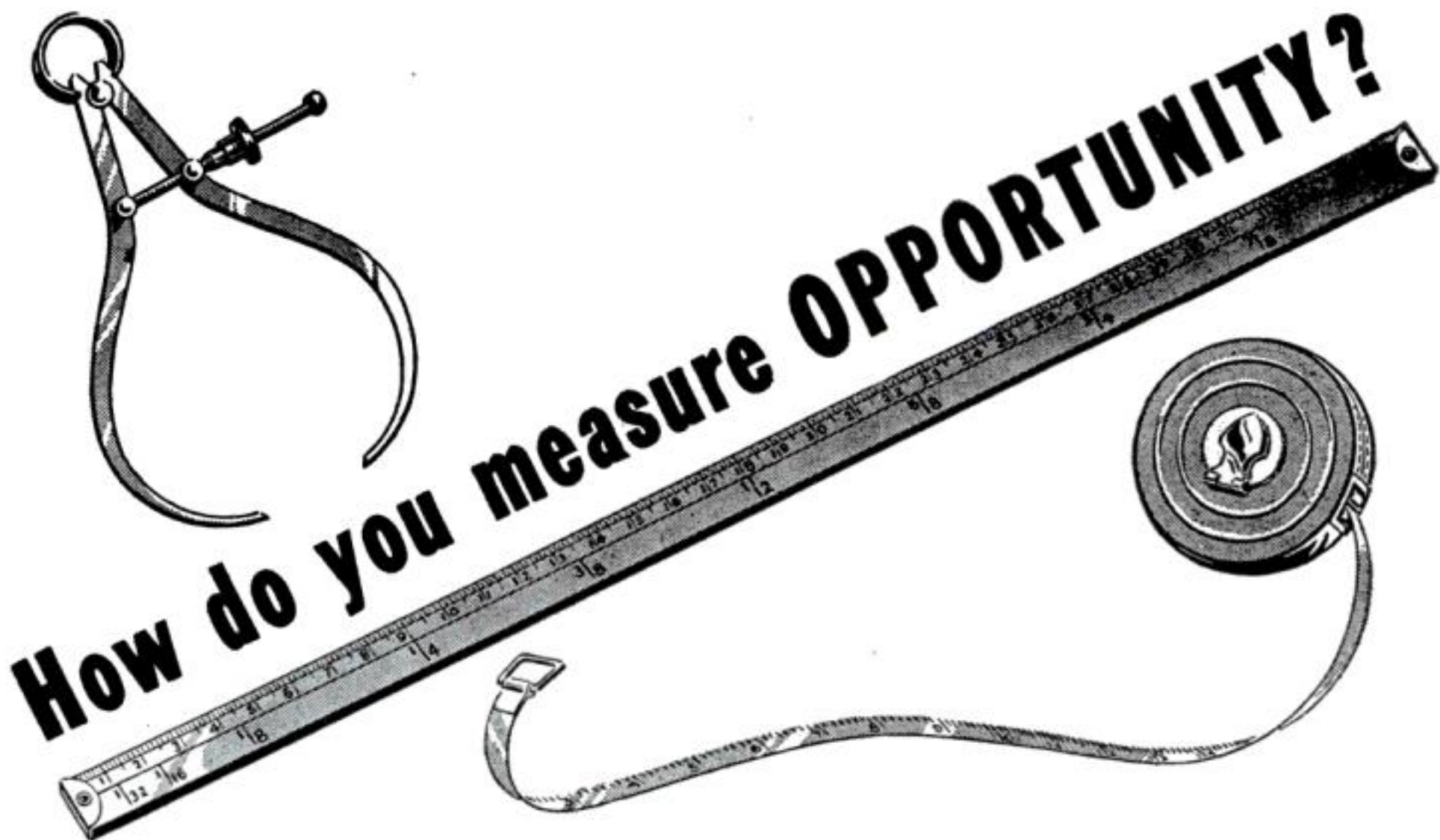
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**YOU MIGHT** use a mechanic's micrometer or a draftsman's dividers, a surveyor's tape or an engineer's rule, but only with *training* can you hope to get the fullest measure of *opportunity*.

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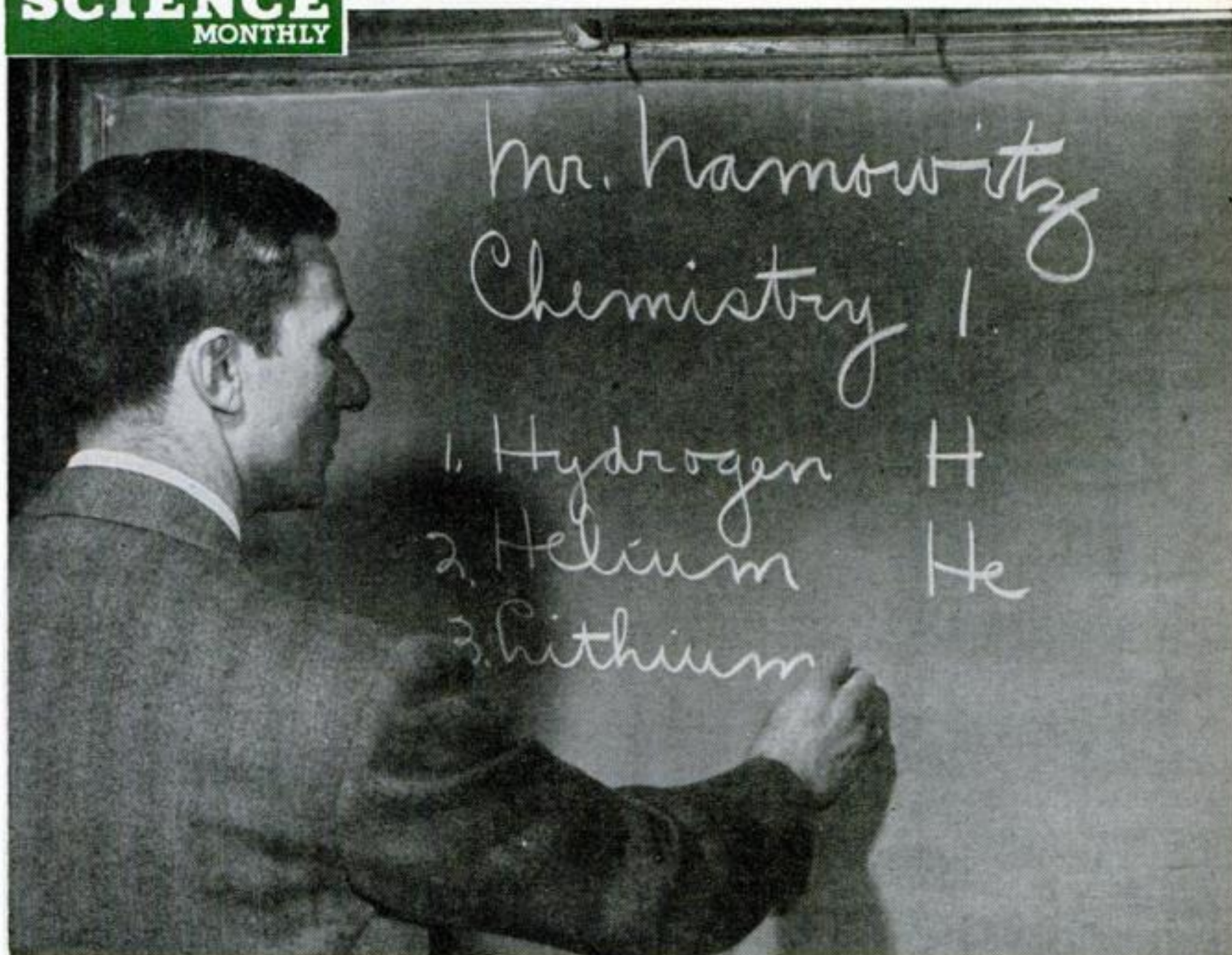
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PSM photo in Washington Irving High School, New York City

## Who Will Teach Tomorrow's Voters?

A GENERATION ago, H. G. Wells closed his monumental *Outline of History* with this head-shaking thought:

"Human history becomes more and more a race between education and catastrophe."

Today, with the bursting atom ominously linked with catastrophe, the race is running faster. Never before was education so vital. Science moves ever closer to the citizen. Yet, as the schools close this month, how many of the teachers are sure to be back in front of the blackboards in the fall?

The outlook is particularly dark for the science courses in the secondary schools. As Elbert C. Weaver, who heads its Committee on High School Chemistry told the American Chemical Society, "This year, 307 teaching certificates in science or mathematics are to be granted out of 120,000 undergraduates in 18 teachers' colleges."

Since the war began, almost half of the

scant quarter-million teachers in secondary schools have left for decently paid jobs in industry. "Of the teachers now on the job," adds Mr. Weaver, "about 15 to 20 percent teach some science, and about one-third of these teach chemistry."

If this is hardly a healthy preparation for citizenship in the atomic age, you know whom to blame, don't you? Or weren't you present when the town meeting voted the new ball field, or the city council slipped through the costly war memorial?

Park, statues, swimming pools, and new civic buildings are good things. But if education is to win the race with chaos, perhaps we would do better to have more—and happier—teachers in front of our blackboards.

*Perry Gifford*





**IF** you're that man, here's something that will interest you.

Not a magic formula—not a get-rich-quick scheme—but something more substantial, more practical.

Of course, you need something more than just the desire to be an accountant. You've got to pay the price—be willing to study earnestly, thoroughly.

Still, wouldn't it be worth your while to sacrifice some of your leisure in favor of interesting home study—over a comparatively brief period in your life? Always provided that the rewards were good—a salary of \$3,000 to \$10,000?

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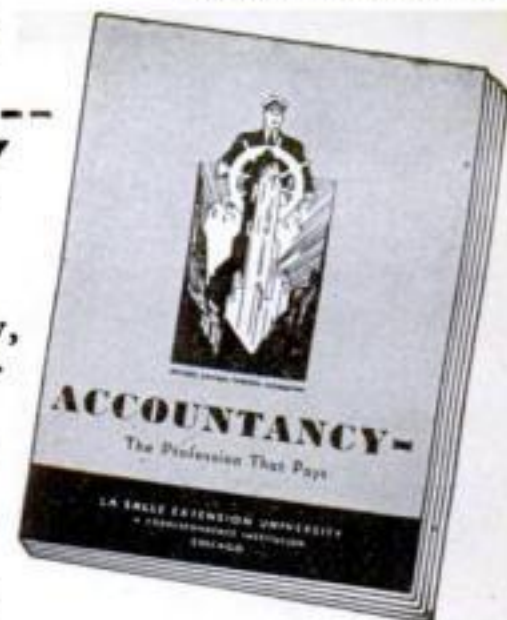
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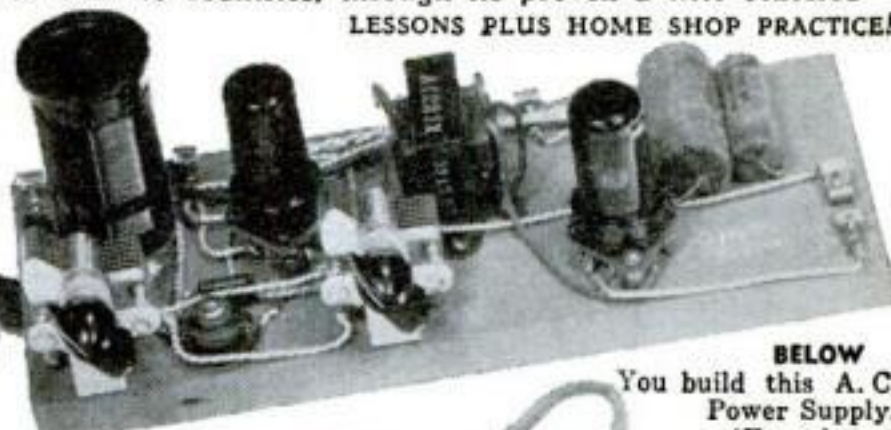
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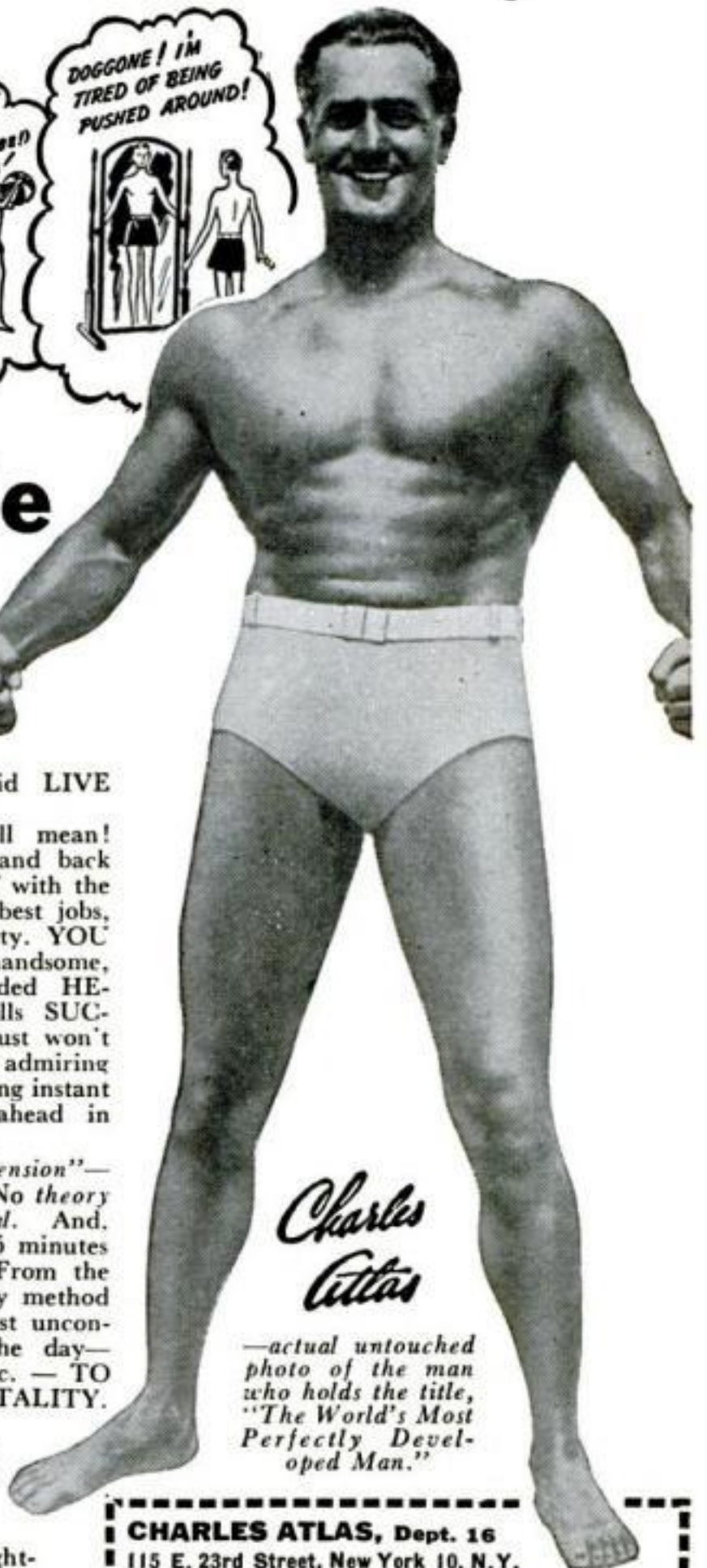
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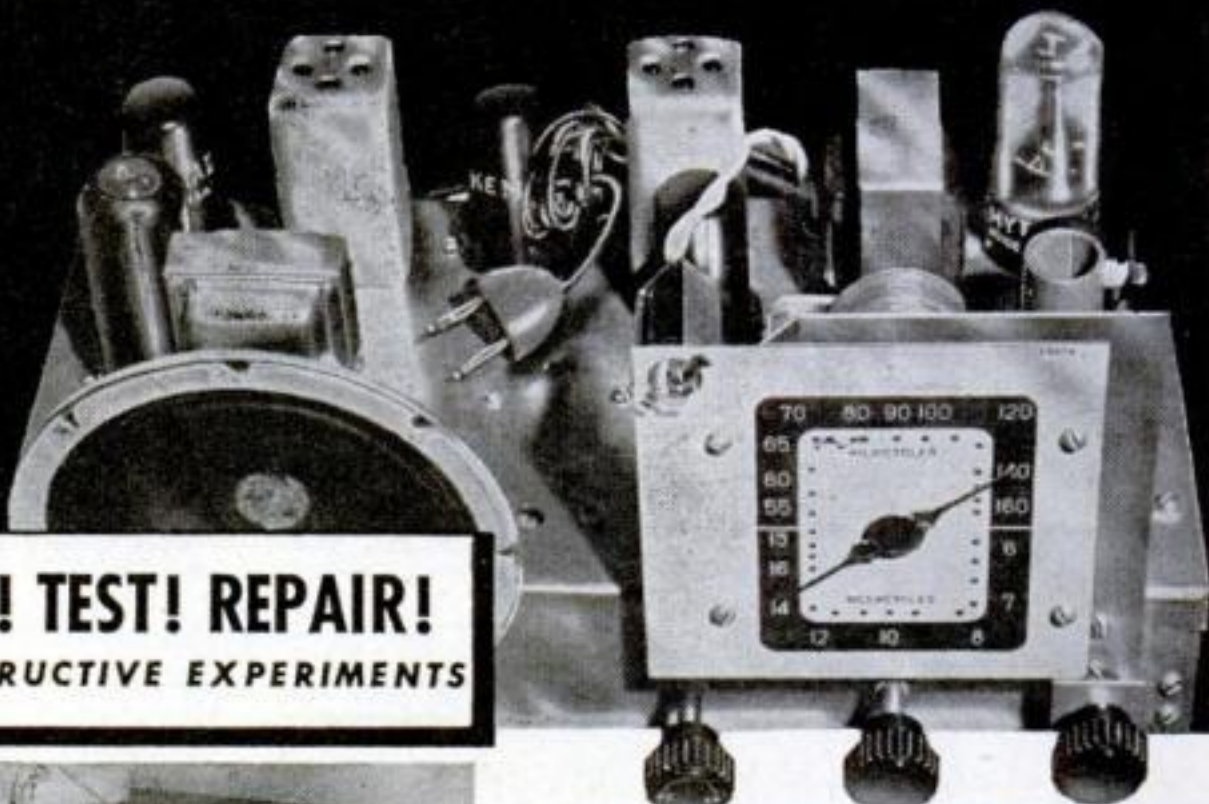
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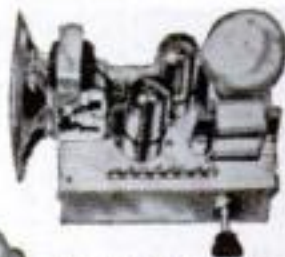
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## **LETTERS**

### **On Behalf of Safety**

Sir:

The article by Devon Francis on "Cars Can Be Safer" in the April issue of your excellent magazine is not only interesting reading, but in addition qualifies as a valuable public service. It directs attention to a major factor in automobile accidents which has been consistently and persistently overlooked—the one common factor in all automobile accidents: the car itself. . . .

If it would cost a little more to design and build safer cars, that cost would be little compared to the \$2,500,000,000 economic loss suffered every year in auto accidents. Furthermore, with cars designed for maximum safety, savings could be made on the great sums expended for traffic regulation and road engineering.

Your article clears the air. The question is, what price safety?

ARTHUR W. STEVENS  
President,

Automobile Safety Association  
Boston, Mass.

*PSM appreciates Mr. Stevens' praise. A letter from him originally inspired the idea for an article on safer cars.*

Sir:

. . . You show a car being blocked out by a large corner post. If this post were made of transparent plastic, there would be no danger of blocking the driver's vision of a car or a person.

IVAN GOLDBERG

Brooklyn, N. Y.

Sir:

Both article and editorial note on safer cars take a commendable attitude, but everyone combating this evil misses the main cause. All main roads should be one way. At the next Indianapolis race, let's have half the cars travel in one direction, the other half in the opposite direction. Hazardous, you say? But isn't that just what everyone



# INVENTORS

## Patent Laws Encourage The Development Of Inventions

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If an inventor believes he has an invention, a search of the most pertinent prior U. S. patents should be made and a report obtained relative to its patentability. Where such report indicates that the invention appears patentable, in order to secure protection, diligence should be exercised in making application for a patent.

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JUNE 1947 17





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J. O. WIGGENJOST

Lincoln, Nebr.

## For the Modelmaker

Sir:

I am writing in appreciation of your recent policy of publishing plans and specifications for model projects outside the ordinary run of aircraft, racing cars and railroads. I have completed the model of the wood-burning "Old Ironsides," and it makes a very nice job. At present, I have almost completed George Washington's coach, and I think it will be a prize. . . . Keep this feature up, and please don't make them too hard or too easy. The two I have worked on are just about right for "table-top" builders.

E. F. DUTTON

Winnipeg, Man.

## Still Aiming for the Moon

Sir:

Regarding your March article on "How You'll Fly to the Moon": I have read in chemistry books that water converted into steam and then passed through a super-heated iron pipe is cracked into hydrogen and oxygen. Would there be a chance that this principle would work, together with the atomic-rocket idea? The H<sub>2</sub>O given off could be burned as the propellant charge.

WILLIAM S. CRUMP

New Albany, Ind.

*The necessary equipment would probably weigh considerably more than tanks of liquid hydrogen. Besides, if hydrogen and oxygen were burned, it would be a chemical rocket, not an atomic one. Atomic rockets won't burn hydrogen—they'll just heat it up a lot.*

## Something Had to Give

Sir:

What happened to the "Letters" department in the April issue?

J. T. PROCTOR, JR.

New York, N. Y.

*The paper shortage is still with us, and "Letters" paid the penalty.*



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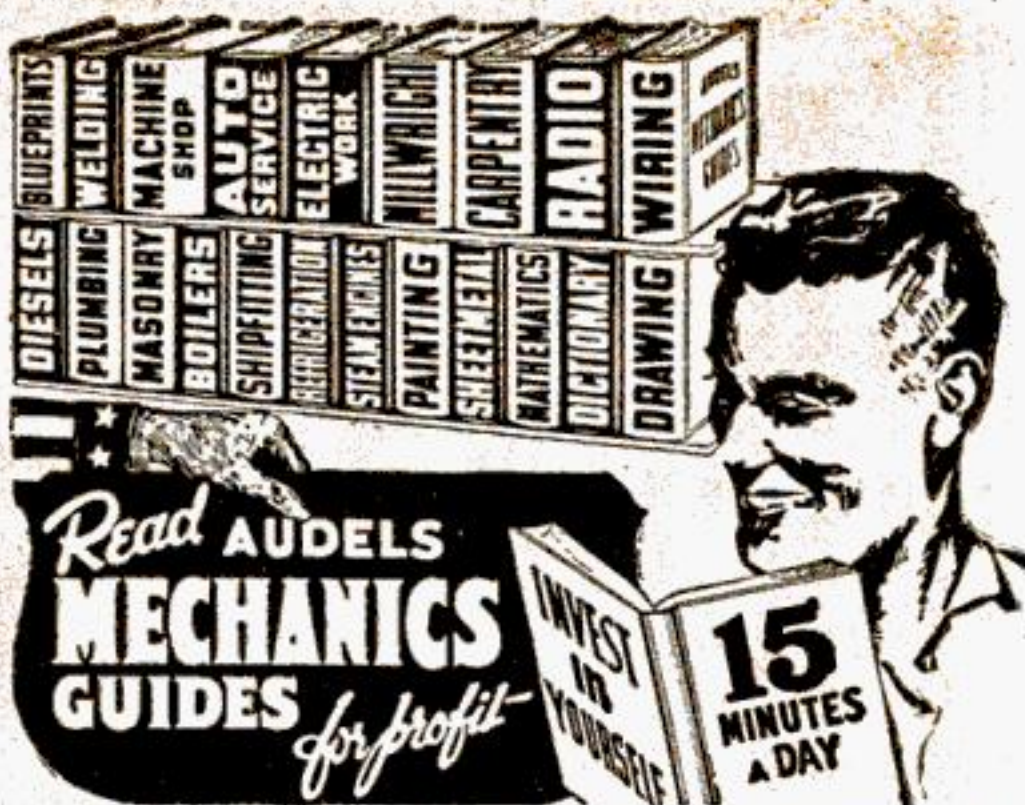
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## Where's Newton?

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On page 77 of your March issue, you ask if a rock placed in a tank of water will weigh more, less or the same as the rock and the tank of water separately. You state that they will weigh the same. Actually, the combination will weigh less. When the rock is added, the water level in the tank is raised, and with it the center of gravity of the whole combination. From Newton's law of gravitation, the attraction between two bodies varies inversely as the square of the distance between their centers of gravity. In this case, the distance is increased (i.e., the distance from the center of gravity of the combination to the center of the earth), so the attraction, and hence the weight, will be less.

ROBERT SQUIRES

Toronto, Ont.

*Sir Isaac himself would have to agree that the principle is correct, but PSM is willing to bet that he wouldn't have bothered about trying to calculate the difference. How much is infinitesimal?*

## Giving Jupiter His Due

Sir:

... Since the discovery of the two new satellites of Jupiter was made nearly 10 years ago, it came as a surprise to find in your March issue a statement that Jupiter had nine, instead of 11, satellites.

JOHN STERING

Deerfield, Ill.

*The copy desk is surprised, too—at itself. Seth Nicholson discovered Jupiter's 10th and 11th satellites in 1938.*

## Praise from Down Under

Sir:

I wish to congratulate you on the recent very great improvement introduced into Popular Science by the elimination of this "turn to page xxx" business. Probably few have written to you about it, but I believe I am speaking for thousands of silent readers in regarding this as a finishing touch to a superb magazine.

A. E. CHARLTON

West Tamar, Tasmania



# ADVICE *for the* INVENTOR

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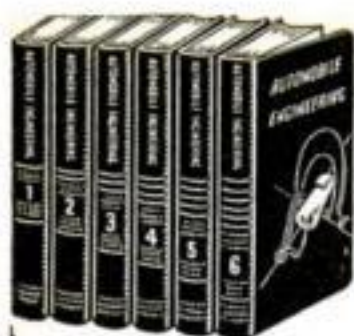
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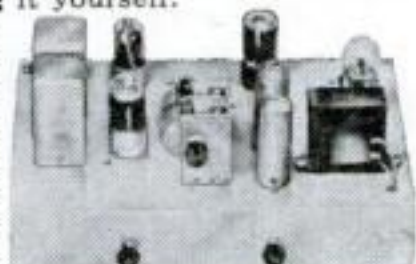
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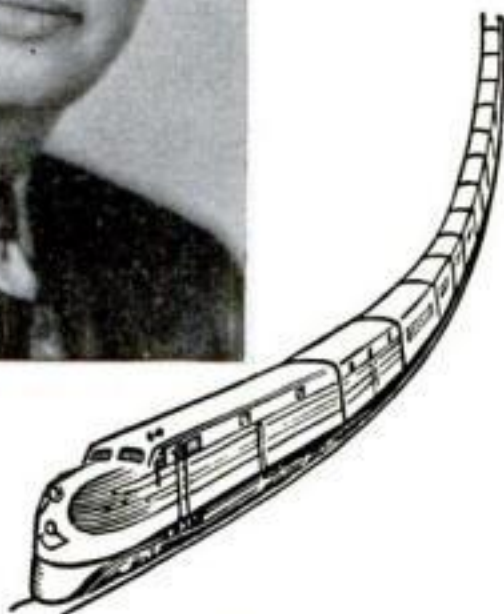
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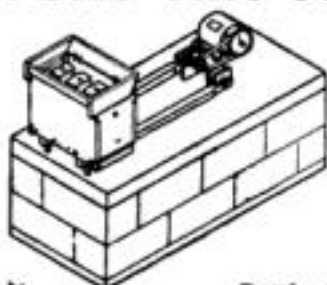
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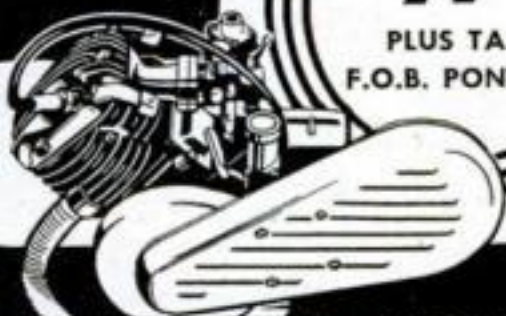
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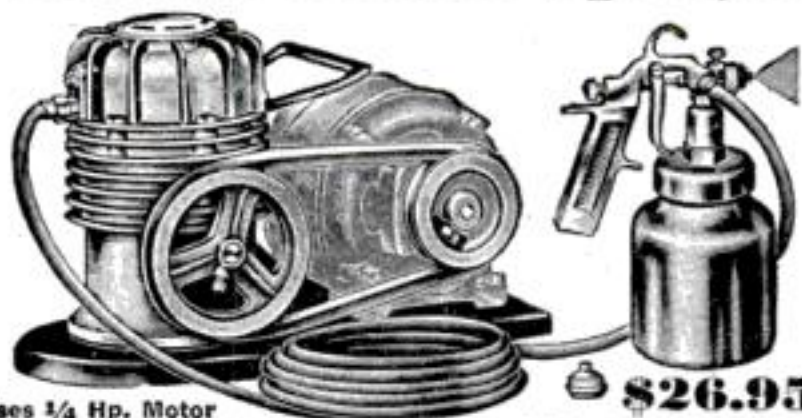
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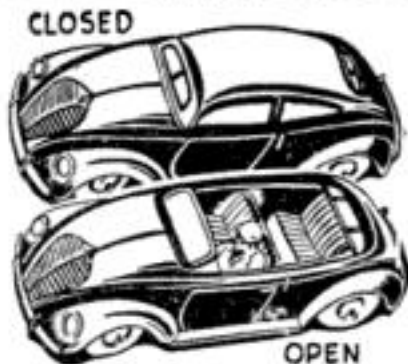
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By EDWARD CHARLES

Nationally known Hollywood Radio Reporter

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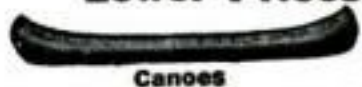
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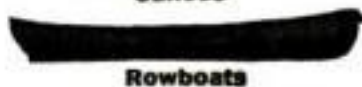
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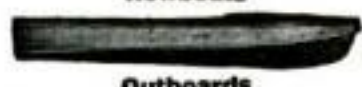
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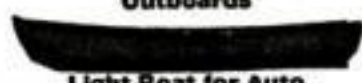
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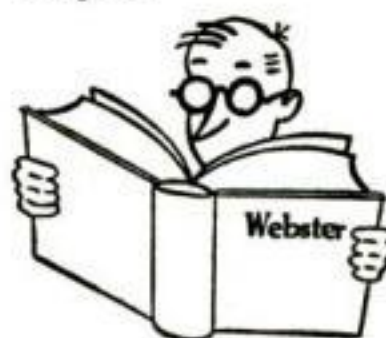
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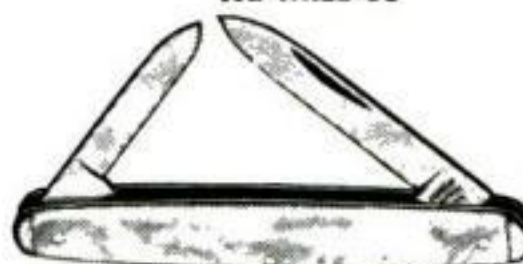
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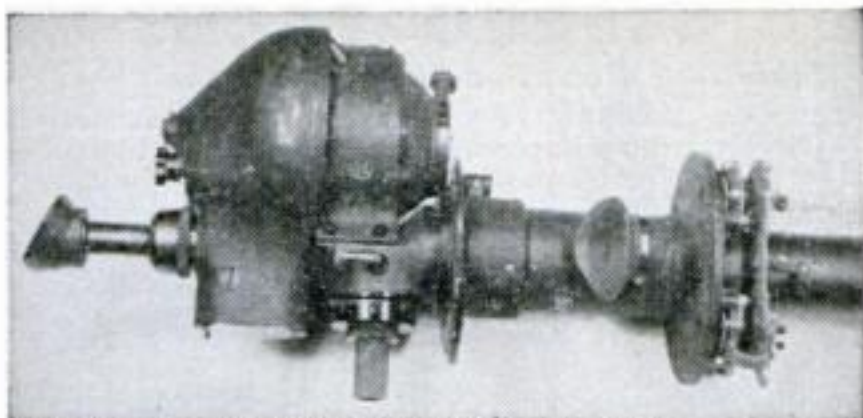
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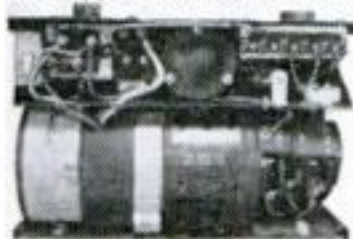


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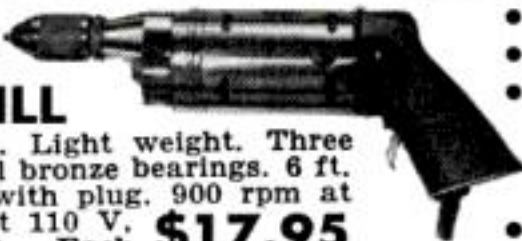


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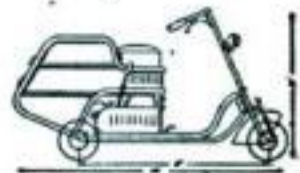
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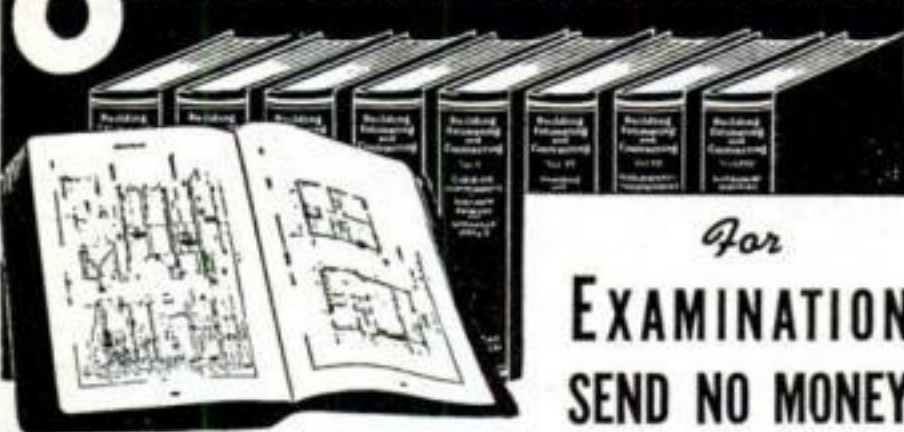
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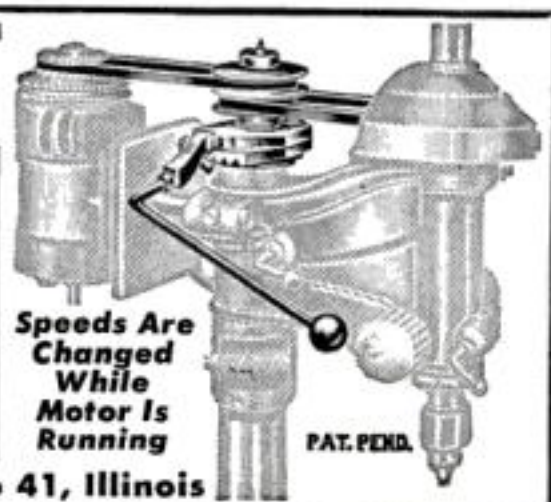
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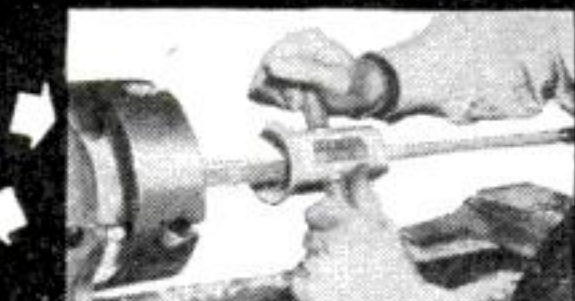
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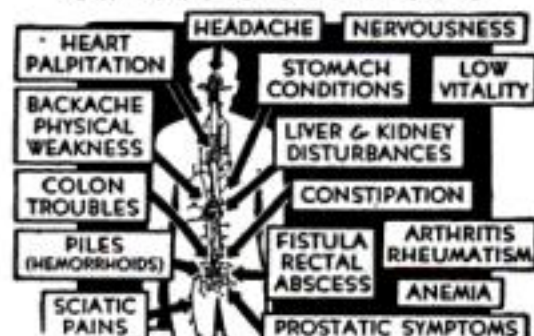
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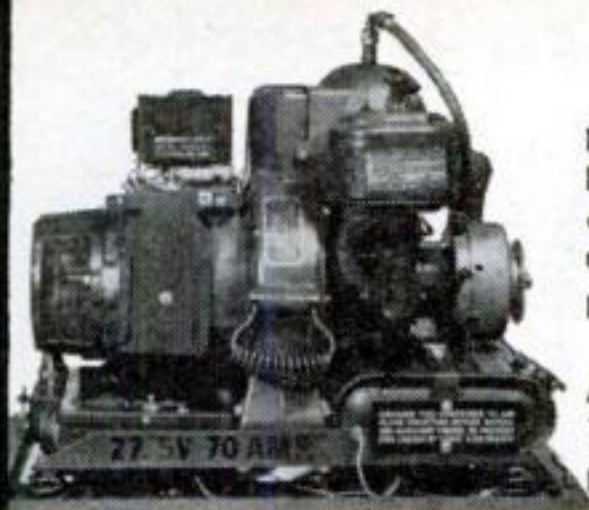
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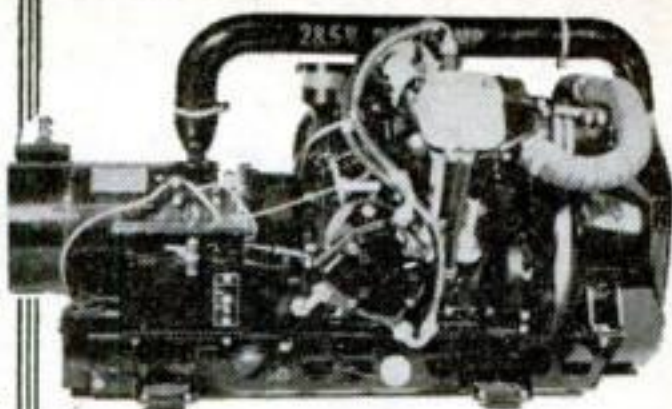
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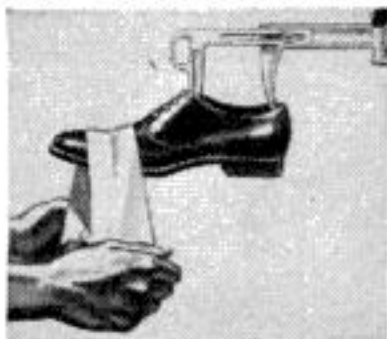
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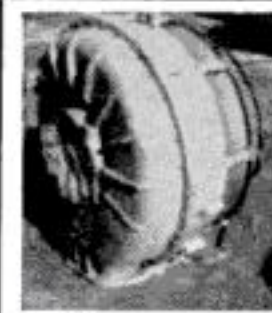
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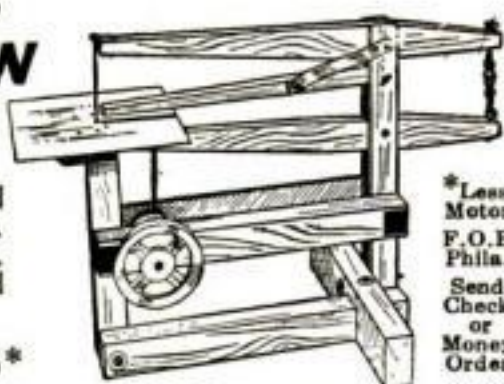
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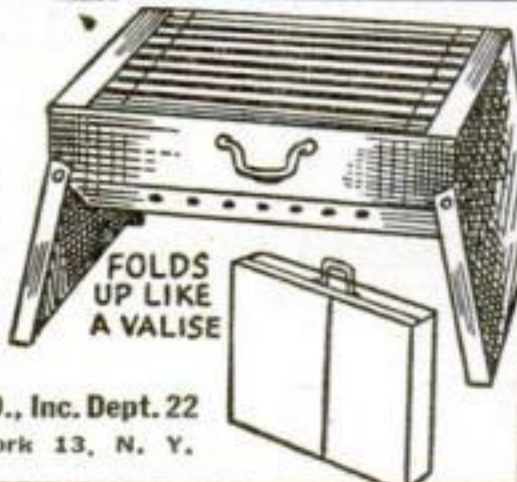
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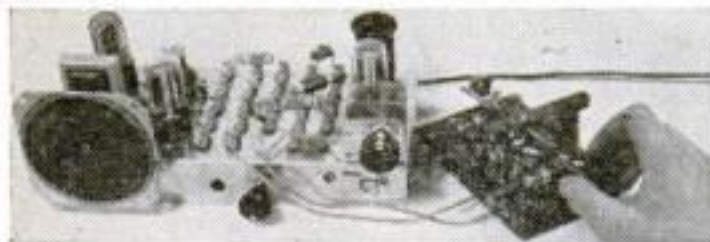
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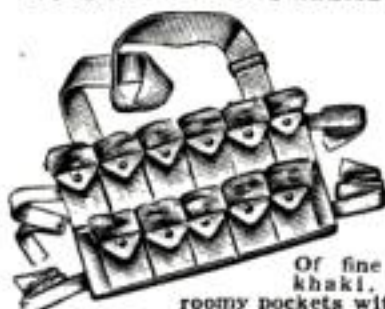
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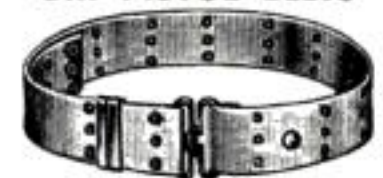
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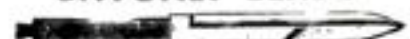
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**BUILD your own Trailer!** Save Money! Have every feature you want! Plans for House, Sport, Camp and Utility trailers. Catalog describing 9 models 10c. (15c in Canada and overseas). Jim Dandy, Box 125-B, Wausau, Wisconsin.

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**WHEELS.** Steel Disc rubber-tired for toys, wagons, scooters, etc. Sizes 5", 6", 7", 8", 10" available. United Wheels Mfg. Co., 11727 La Payette Ave., Chicago 28, Ill.

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**HARLEY-Davidson** Parts, Accessories, Batteries, Tires, and Repair work. 24 hour Service. Authorized factory dealer, Philadelphia Harley-Davidson Company, 857 North Broad Street, Phila. 23, Penna.

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**AIRLINE** employment interest you? Write for helpful, free information, Air Transport Research, Dept. E, Box 1044, Kansas City 10, Missouri.

**LEARN** Aviation—300 Page Illustrated course \$1.50. Craig Dare, 140 W. 42nd, N. Y. 18.

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**BUSHEL** Basket of damaged Aircraft instruments, our choice, \$24.94. No COD's. State Express or Freight. Aero Instrument, Municipal Airport, Houston, Texas.

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**TRAIN** For Aviation Mechanics High Salaries. This famous school approved for veterans. Immediate enrollment. For information write California Flyers, Department P-6, Inglewood, California.

## 49 ELECTRICAL SUPPLIES & EQUIPMENT

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**ELECTRIC** Pencil: Writes, Engraves all Metals. \$1.00 postpaid. Beyer Mfg., 229-C Dixon Blvd., Uniontown, Penna.

**FANS,** irons, clocks, motors, toasters, radios, etc. Jeanette Electric, 159 West 23rd St., N. Y. 11, N. Y.

**HOUSEHOLDERS** Attention: Repair your own electrical equipment. Detailed instructions on motors, fluorescent lamps, etc. 50 cents E. W. Lutz, 182 W. Como Ave., Columbus 2, Ohio.

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**SELSYN** motors, Bendix 3 1/2" x 5 1/2" heavy duty 115 volts, 60 cycles, \$10.25 per pair. J. A. Weber, 150A Maple, Hershey, Pa.

**THERMOSTATS** — special 40c — 3 for \$1.00—capsule type—over 600 degree adjustable range—not calibrated—cap. 40 watts—dozens of experimental uses—out-fire control—limit control—low temp. control. A.C. Voltmeters—Triplett license—0-150—new—3 1/2"—Bakelite—white dial—special \$3.45. A.C. Ammeters—0-100—same as above—only \$2.95—Postpaid. Send check or postal order. D. E. Kitchen, Logan, Ohio.

**LAMPS**—All parts to build or repair. Catalog 10c. Gyro, 5416 Clark, Chicago 40.

**WASHING** Machines. Parts all makes. Northeast Burner, 1358 H Street, Washington 2, D. C.

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**IT'S** Easy to build your own metal and woodworking tools from Lewis castings. Materials and blueprints—and at savings up to 80%! Lewis mills, shapers, drill-presses and other shop tools have ample capacity and performance for home workshop jobs. New catalog sent on receipt of 10c to cover mailing—describes 23 Lewis tools. Address Lewis Machine Tool Co., 3217 Union Pacific Ave., Dept. S, Los Angeles 23, Calif.

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# POPULAR SCIENCE OPPORTUNITIES

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**TAPS & Dies** direct from manufacturers. Equip your shop at small cost. Write for free price list. King Tap and Tool Co., Inc., North Attleboro, Mass.

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**V BLOCKS** at low prices. 10 sizes for all purposes. Free Literature. Miles Products, 2532 Wabash, Chicago 16.

**PROPELLERS** for ice-snow sleds, air boats. catalog 10c. Banks Propellers, R.F.D. 12, Ft. Worth, Texas.

**CIRCULAR Saws** \$1.00 each. Approx. 6". Used but good condition. 1/2" center. Postpaid. Jermin, R. 6, Box 97, Mt. Clemens, Michigan.

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## 19 BOATS, OUTBOARD MOTORS, ETC.

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**MARINE Plywood.** Phenol Resin glued, made to U. S. Navy specifications for PT boats. 1/4" thick, 3 ply. Mahogany on two sides, some with Mahogany centers. 3' x 8', 3' x 6' sheets. 34 cents square foot. FOB Chicago. Beck Plywood and Lumber Co., Inc., 617 W. Division St., Chicago 10, Ill.

**SPORTSMEN!**—Build wonderful fold-craft Kayak. Plans for 10 1/2' or 15'. Rush \$1.00 today. Hoosier House B-2, P. O. Box 1264, Indianapolis 6, Indiana.

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**"BUILD Your Own"** gas drive arc welder easily with Hobart Generator. Save \$300 to \$500, and need only add used auto engine and chassis to build portable gas drive welder that goes everywhere after profitable construction and repair jobs. Write for free instruction book, further details. Hobart Brothers Co., Box P-1066, Troy, Ohio.

**WINDING Data,** listing 225 motors, single and three phase, \$1.00. Motor Data, Box 7631 Kansas City 3, Mo.

**150 AMPERE Generators** for welding \$47.50. Extra Flexible Cable, 6 ft. lengths \$2.75. Other Bargains. Butler Electric Company, 1885 Milwaukee, Chicago 47.

**ELECTRIC Motors** 110 Volt AC-DC 1/2 horsepower 8000 R.P.M. (Reconditioned) Marvelous Value \$6.50. Limited Quantity. B. Price, 1394 Fulton Avenue, Bronx 56, New York.

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**BAR-BELLS, Dumbbells, Exercise equipment, Courses.** Free booklet. Good Barbell Co., Reading, Penna.

**BARBELLS!** Catalog! Bur Barbell Co., 319 Orient Way, Lyndhurst, N. J.

**1947 NEW Low Prices.** Burgo Barbells, 405 Martinique, Dallas 10, Texas.

**BOWLEGS,** straighten them simply, easily, and quickly. Different, successful, system. Hutson, Box 54, Oakfield, N. Y.

**ACROBATICS**—handbalancing, self-taught. Write. Power, 923 W. Vine, Kalamazoo, Michigan.

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**5000 BARGAINS,** firearms, binoculars, war relics, catalog 40c. Smith Museum, Runnemede, N. J.

**BOWS-Arrows.** Write headquarters for Archery equipment. Quality products. Popular prices. Catalog 10c. Large illustrated Hand Book Instructions, making and shooting. 50c. Archery, 617-A So. State, Chicago 5.

**SEND 10c** for list 100 new and used guns. Frayseth's, Wilmar, Minnesota.

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**BASEBALL Fans**—for \$3.00 make this new pitching device. Practice batting in back yard. Duplicates curves. Delivers regulation baseball every 5 seconds. No fielding. Plans \$1.00. A. Rankin, Route 4, Hagerstown, Md.

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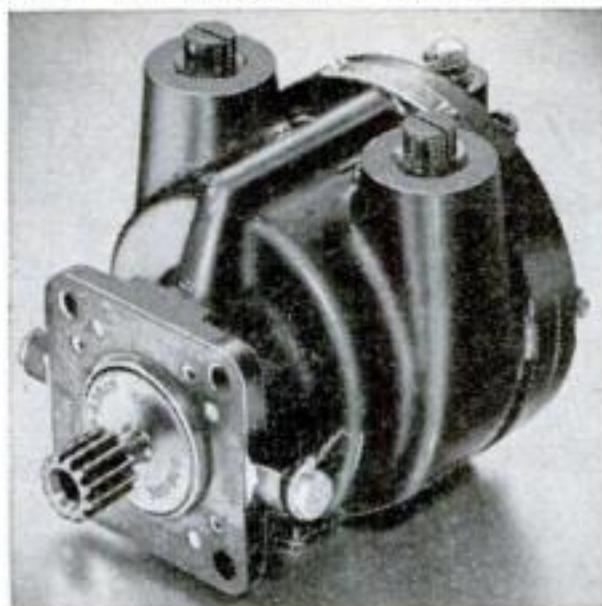
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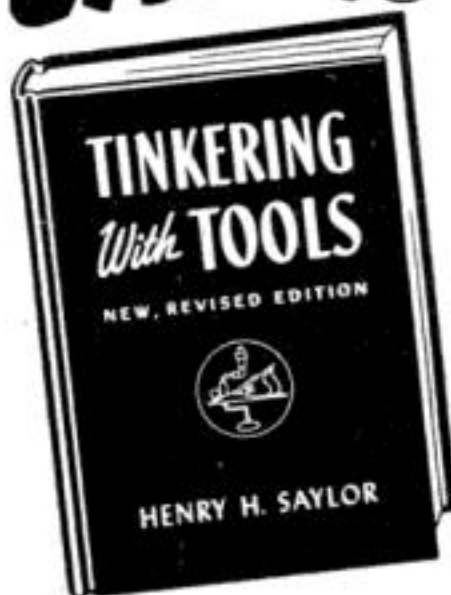
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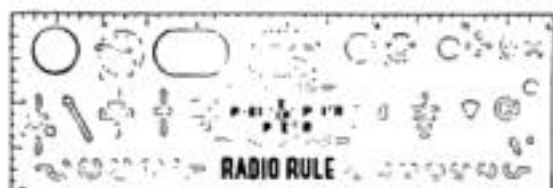
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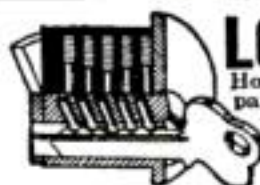
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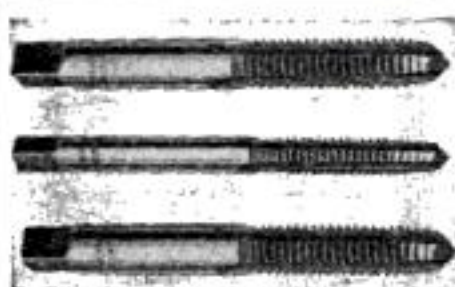
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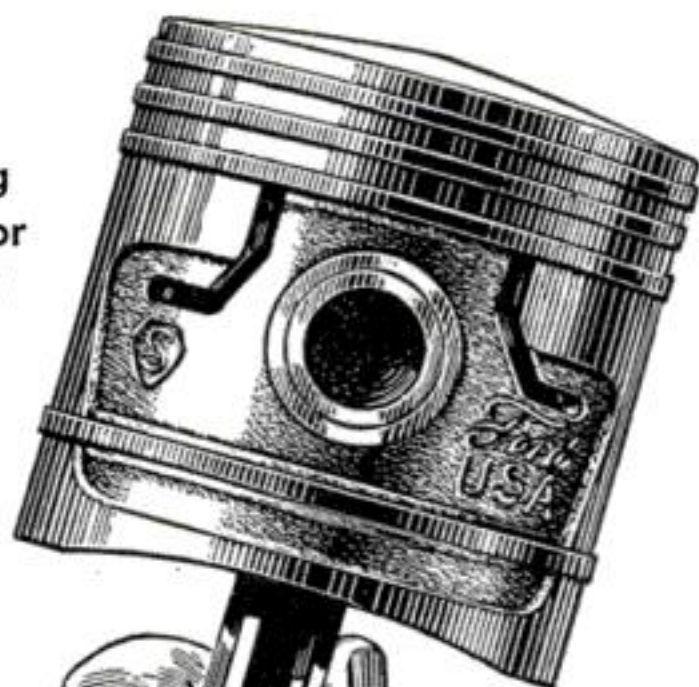




# "Blow-by" gets the "go-by" from Ford's 4<sup>th</sup> piston ring!

**Here's what** that extra ring in every Ford piston does for you. It gives you power you never dreamed of, by reducing compression loss or "blow-by" to an absolute minimum. In addition, you also get better control of oil film on cylinder walls. This cuts down the amount of oil reaching combustion chambers. And that means oil savings!

With features like these, no wonder Ford engines—both SIX and V-8—are far "out front" in their field.



The ring in the bottom of the skirt removes most of the oil. The upper oil control ring allows just the right amount of oil to pass to lubricate the compression rings and prevent scuffing.

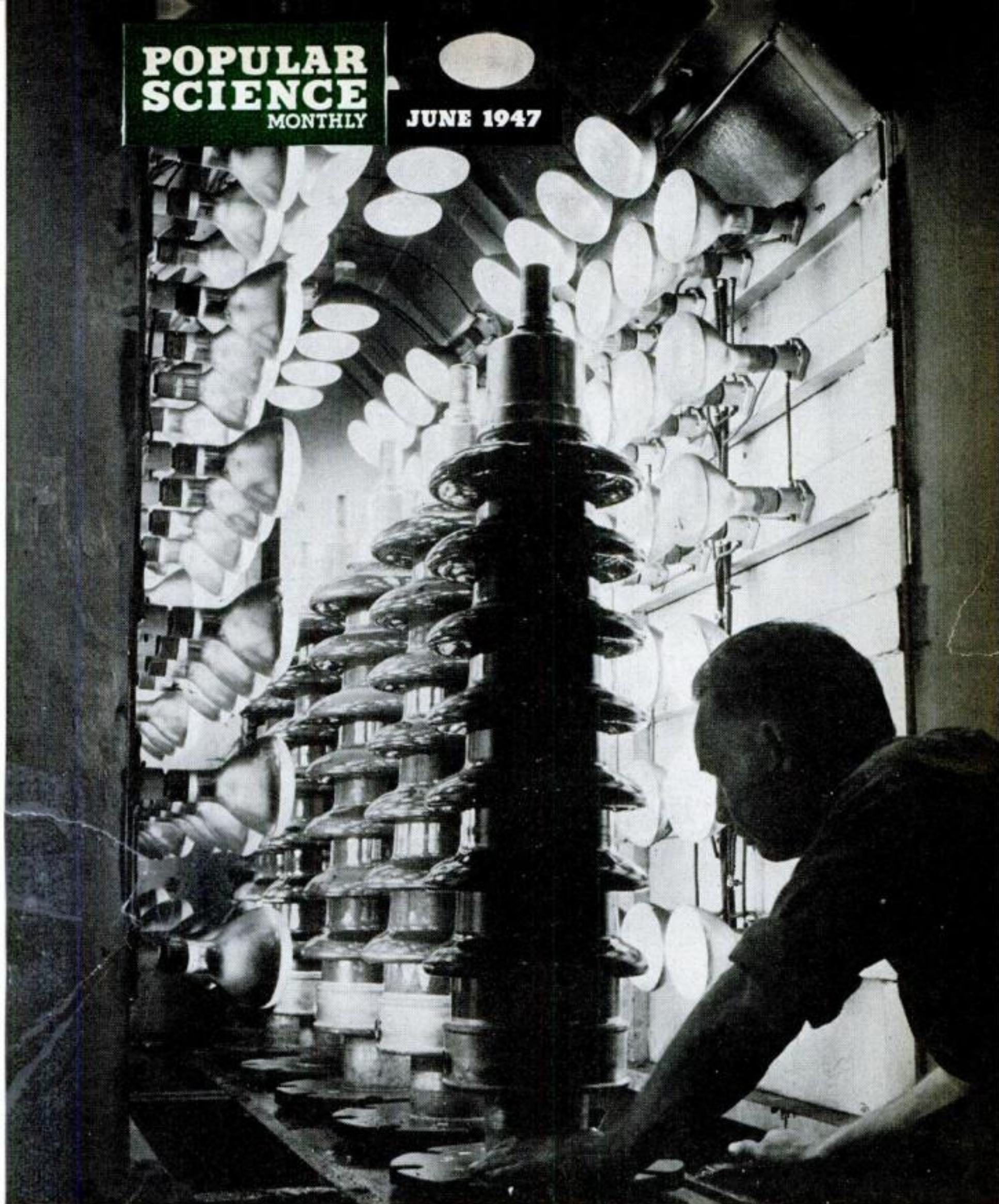
Teamed with this 4-ring feature, Ford gives you aluminum alloy pistons. Their double advantage of lighter weight and higher heat conductivity reduces bearing loads and keeps rings from sticking. And Ford pistons are slotted and cam-ground to best fit cylinders for slap-free oil economy.

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***“Cooking” with Light...*** A battery of 120 infrared lamps, massed in this tunnel of light at the Westinghouse plant at East Pittsburgh, serves as a preheating furnace for big porcelain condenser bushings—the channels by which high-voltage currents reach transformers and circuit breakers. The bushings, on their way to receive a filling of insulating plastic, are heated to about 266° F. to prevent them from cracking, as they would otherwise, when the plastic is poured at that temperature.





Painting by Eric Sloane

**Advancing from man-made snow  
to man-made weather, science  
and the AAF are ready to battle  
costly storms that batter U.S.**

# The War Against Hail

**By Martin Mann**

**T**HE morning of Aug. 18, 1925, was hot and muggy in the flat farm lands of southeastern Iowa. The green, tall corn, almost ready to husk, grew so fast you could almost hear it. Off to the west, heavy thunderclouds promised a cool evening. Instead they brought disaster that even a city man could feel in his heart and pocket.

Midmorning, it hailed.

A half hour later the corn was only a worthless mush pounded into the ground. Poultry and livestock had been killed, windows broken, roofs smashed, automobiles damaged. *Those terrible 30 minutes cost the local farmers \$2,500,000.*



**Hailstones** as big as this 1940 Oklahoma sample, riding 100-mile-an-hour winds, can kill cattle.

This one storm was not the worst. Between June 7 and 20, 1928, hailstorm after hailstorm bombarded Kansas. The loss: \$11,200,000. Only last year, on May 16, a four-minute blast of hail swept San Antonio. That evening's bill was \$5,030,000.

But soon the tribute paid to hail—totaling almost \$60,000,000 in 1944—may be saved for better purposes. The war against hail has been declared. This summer, the Army and Navy will try to convert brutal hailstorms into gentle showers of rain.

Airplanes of the AAF Weather Equipment Flight Detachment will scatter silver iodide smoke or dry-ice pellets through the huge cumulo-nimbus thunderclouds that often produce hail. This "seeding" is expected to change the clouds to snow, which will melt to rain before reaching the ground.

According to Vincent J. Schaefer, the General Electric Company scientist who was the first man to start a snowstorm (PSM, Jan. '47, p. 78), the seeding might also be done by sending up rockets or drone planes equipped with automatic smoke or dry-ice dispensers, or setting up portable smoke generators on the ground so that the strong updrafts generally accompanying hailstorms would suck the smoke seeds into the clouds.

The clouds from which hail falls are tall, turbulent pillars of supercooled water vapor





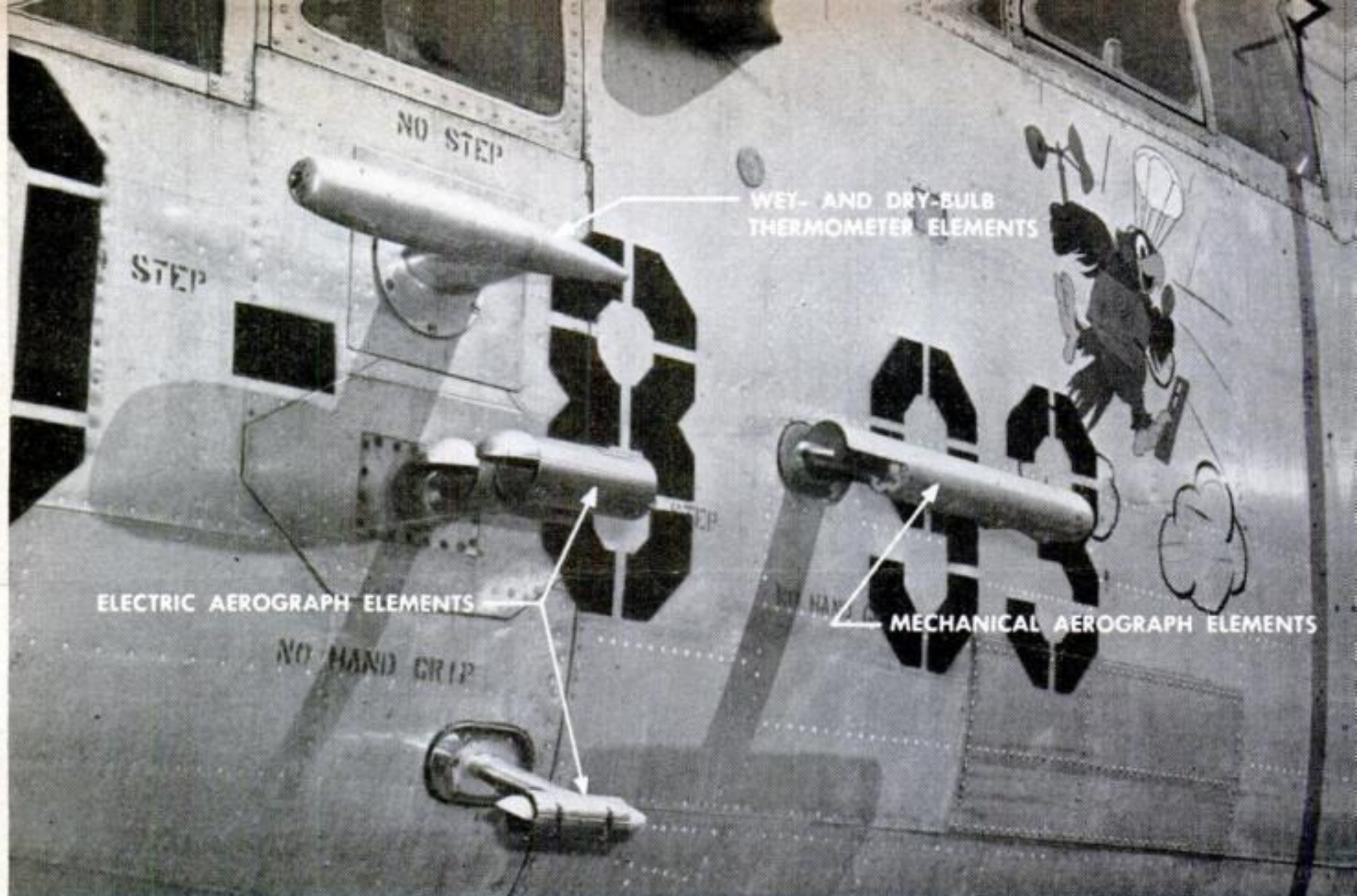
PSM photo by W. W. MORRIS

**Set for take-off** on a weather-control mission, Capt. C. N. Chamberlain, Jr., waves from his spe-

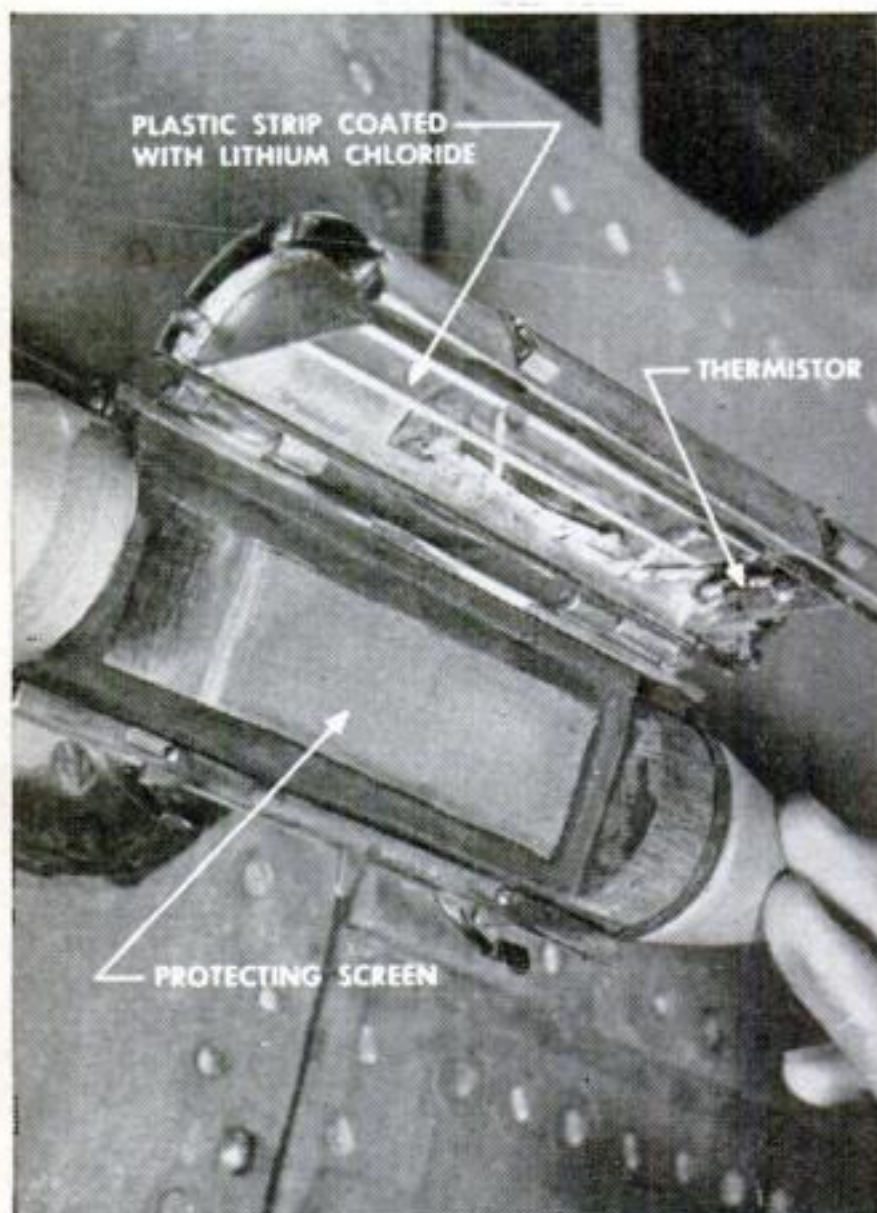
cially equipped B-25. He is a pilot in the Weather Equipment Flight Detachment of the AAF.

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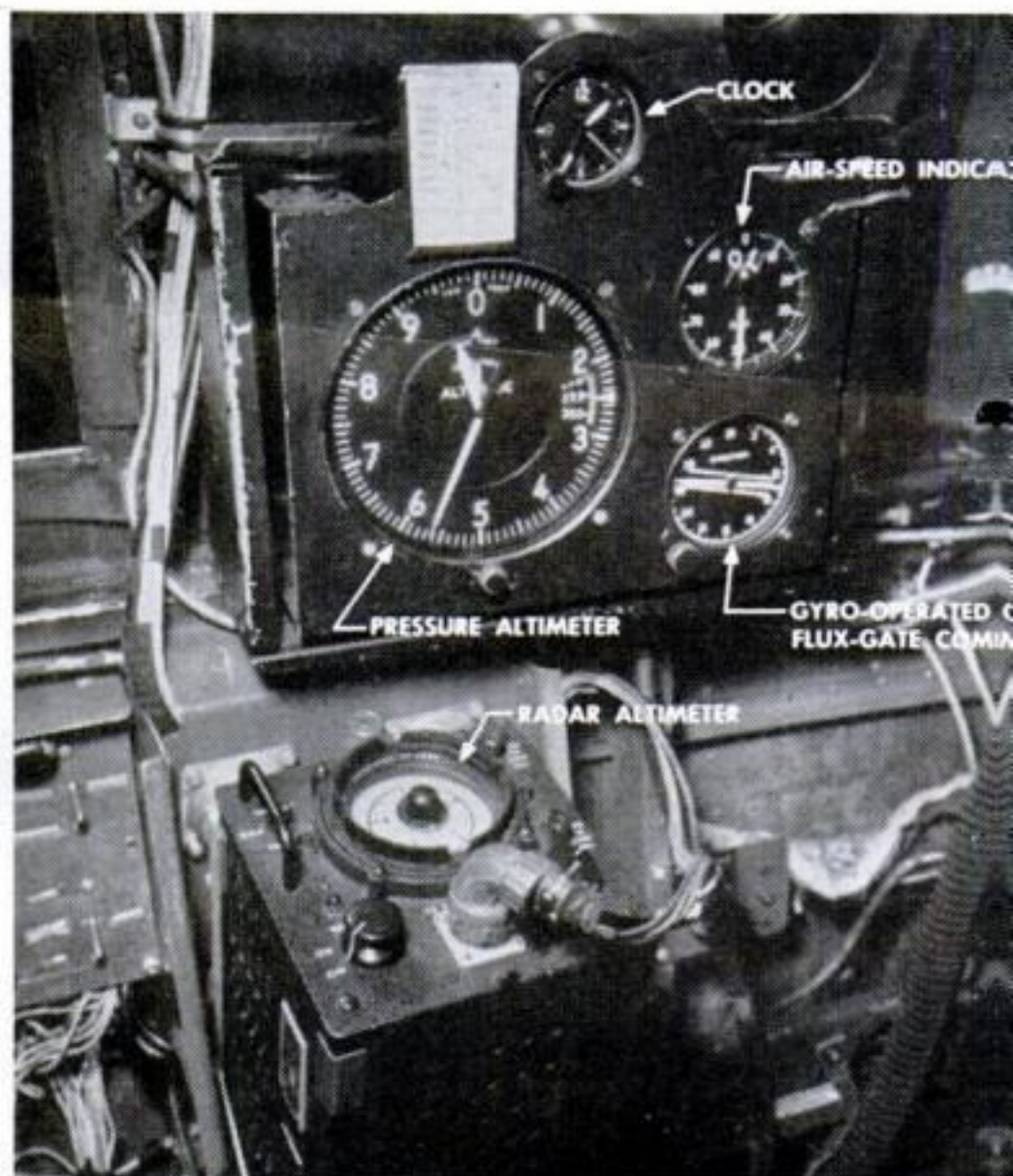




**Aerographs** on the side of this weather plane measure temperature and humidity, recording them automatically. The wet- and dry-bulb thermometers are used to calibrate the aerograph readings.



**Electric aerograph's** thermistor measures temperature; the lithium chloride unit, humidity. The screen filters out dust and liquid moisture. A mechanical aerograph has a human hair to tell humidity, a bimetal strip for temperature.



**On a test flight,** the weather observer must record altitude, airspeed, course and other information. The radar altimeter provides a reading of actual height above the earth for comparison with altitude shown by the pressure altimeter.



(tiny drops of water that are colder than the freezing temperature, 32° F., but have not yet frozen). The droplets are caught in the strong updrafts and thrown to cold, high altitudes. There they freeze, then plunge down, and grow in size as more moisture freezes on them. The updrafts may whip them up repeatedly and cause them to acquire other shells of ice as they fall again. A hailstone 17 inches in circumference fell at Potter, Nebr., on July 6, 1928!

Such a natural ferris wheel could be stopped by removing all the water at once. Silver iodide crystals trick droplets into freezing on them; iodide crystals look just like ice crystals, and water vapor can't tell them apart. It freezes around them just as it does around an ice crystal. Dry ice works differently. It produces huge quantities of submicroscopic ice nuclei, each containing only a few molecules. This crystallization process releases heat that causes turbulence, spreading the ice crystals throughout the cloud. They then act as natural seeds and change the entire cloud to snow.

In both cases all of the cloud is converted into snow particles, leaving no supercooled moisture to form huge hailstones. Either method is cheap: one pea-sized pellet of dry ice could conceivably produce 300,000 tons of snow, and 200 pounds of silver iodide would seed the whole United States.

### *Army Seeks Ice-free Air*

Basically, seeding "triggers" a supercooled cloud, making it give up moisture before it naturally would. Since hailstorms are not the only kind of weather born in supercooled clouds, this method has other valuable uses.

It could eliminate the supercooled clouds that cause icing over airfields. This is what the Army is now trying to do.

It could stop the snowstorms that come in from the Great Lakes every winter, paralyzing Buffalo and choking its vital rail yards. The snow clouds could be triggered while still over the lakes.

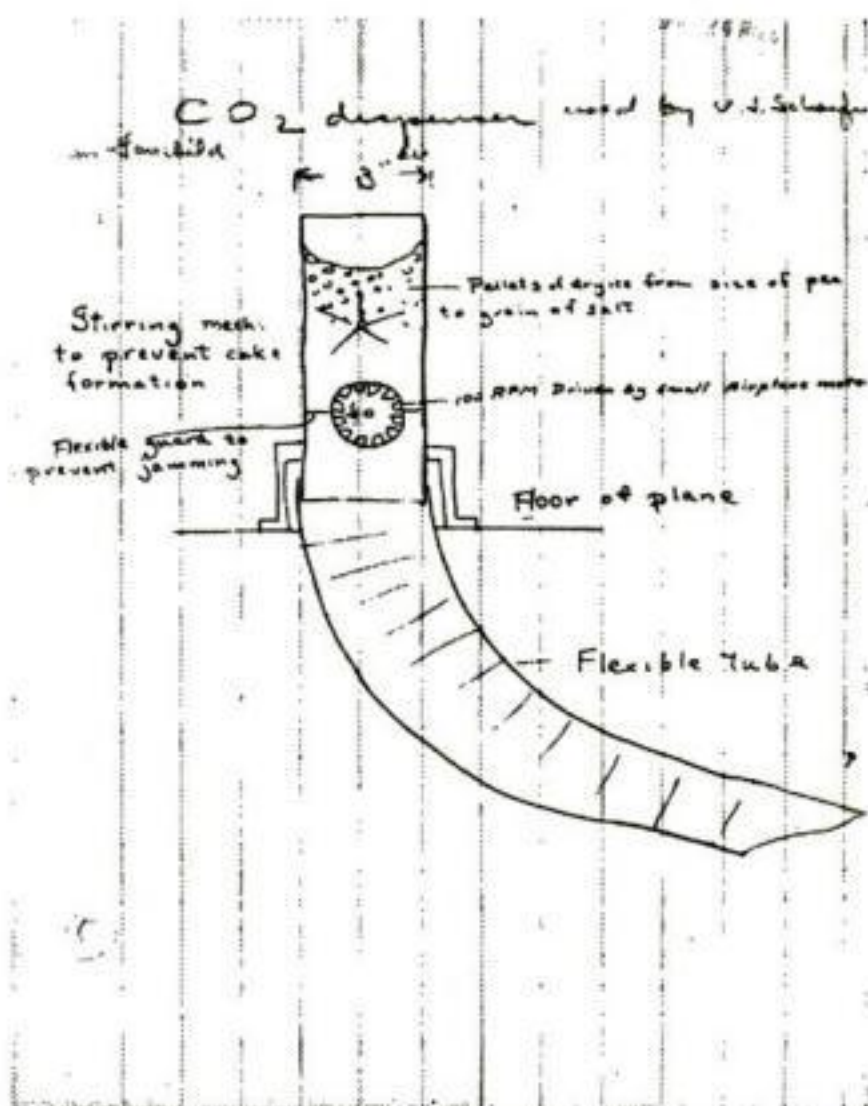
It might make rain in some deserts—possibly convert them to fertile farm lands. Supercooled clouds frequently pass over desert areas only to evaporate into dry air.

Its military possibilities are almost fantastic. Snow and rain forced at strategic points could cripple communications. Rain clouds might be triggered before they reached "breadbasket" regions, and drought and famine would soon cripple the foe.

Although changing a cloud into snow is



Dry ice is poured into this distributing device, mounted in an airplane's floor, to seed a cloud.



Schaefer, the first man to make snow, dashed off this rough sketch of his dry-ice dispenser for PSM. Even this gadget isn't really necessary, according to Dr. Langmuir. He says the dry ice could be sprinkled out of an ice-cream box.





**From this supercooled alto-stratus cloud, dry-ice pellets produced the first man-made snow.**

fairly simple (on p. 88 you can see how to do it at home), it took lots of hard work and brilliant reasoning to find that out. The research can be traced back more than 20 years to the famous small-particle theory of Dr. Irving Langmuir, a Nobel prize winner who is associate director of the GE Research Laboratory and Schaefer's boss.

For almost as long, Schaefer has been interested in snow. Although he left school at 16 and has spent practically every spare minute since then educating himself into a top-ranking scientist, he still found time to go skiing. That led to a study of snowflakes.

Schaefer discovered that supercooled

water vapor suddenly changes to snow at  $-31^{\circ}$  F., and, still more interesting, that only part of the vapor need be cooled that much to turn a whole cloud to snow. A little dry ice (temperature:  $-110^{\circ}$  F.) chills a cloud enough to start snow.

On Nov. 13, 1946, he tried dry ice on a real cloud—a three-mile alto-stratus 14,000 feet over Greylock Mountain, Mass. That three-mile cloud turned completely into snow!

Snow-makers were quickly developed. The dry-ice dispenser is basically no more than a funnel, and the generator for silver iodide smoke consists only of an oxyacetylene torch, an electric motor and a jet of cold



**Opening a pop bottle (left) or pricking a tiny balloon (right) in a supercooled cloud allows gas to expand, lowers temperature and creates a**

**snowstorm. Dr. Langmuir (center) produces the necessary cloud by blowing into a cold chamber as Schaefer and two Army observers look on.**





Curtains of snow begin to fall as ice germs grow at the expense of minute water droplets.

air. The motor slowly feeds string impregnated with silver iodide into the torch flame. The cold-air jet then condenses the silver iodide vapor into tiny particles the right size for snow seeds.

Schaefer's seeding technique works on only a single kind of cloud: one made of supercooled water vapor. But if there is a trigger that eliminates supercooled clouds, there must be other triggers for other clouds. With enough triggers, weather could be made to order!

#### *Seeking the "Why"*

Already scientists are looking for those other triggers. At the Institute for Advanced Study in Princeton, N. J., Dr. John von Neumann hopes to find the "why" of weather—the foundation on which weather control must be built.

Right now we know precious little about weather, but meteorologists have learned that weather changes are caused by such things as the varying amounts of heat received from the sun, the rotation of the earth, and the presence of oceans and mountains. These causes have even been reduced to mathematical formulas. Unfortunately, the formulas are so complicated that a whole crew of mathematicians would have to work until next week to figure out tomorrow's weather!

This hurdle seemed insurmountable until the war brought amazingly fast automatic computers. Now a new type, employing a tube that can "remember" thousands of

numbers (see p. 144), is being built by the Institute for Advanced Study and the RCA Laboratories. In minutes, it can solve problems that would take years by ordinary methods.

With the new computer, Dr. von Neumann plans to test the weather equations, comparing their predictions to the actual weather, then correcting the equations until reliable long-range forecasts can be made.

Once the weather equations are perfected, Dr. von Neumann and Dr. V. K. Zworykin, vice-president of RCA Laboratories, foresee their use to control weather through "model experiments." Figures corresponding to imaginary weather conditions will be fed into the computer. It will then forecast what weather would have resulted. For example, the machine would show how a higher temperature over the Caribbean Sea would have affected the weather in Miami.

#### *Imitating an Island*

Only small temperature difference at one critical location can produce radical weather changes, says Dr. Zworykin, citing small ocean islands as an example. In the daytime, the temperature above the island is a few degrees higher than the temperature above the surrounding water because the island surface absorbs more heat from the sky than the water does. This is enough to produce updrafts that cause clouds to rise high above the island, being cooled in the process so that they turn into rain.

Dr. Zworykin proposes to imitate this



natural triggering process by creating artificial areas that could be either highly absorbing or highly reflecting. A thin layer of carbon black would absorb heat. By covering it with white smoke, it would become reflecting.

These areas would have to be placed in exactly the right spots and used at exactly the right times. Haphazard changes in the heat put into the air could make no change in the weather—the forces involved are far too great to be influenced directly. Yet the energy absorbed by a few square miles of

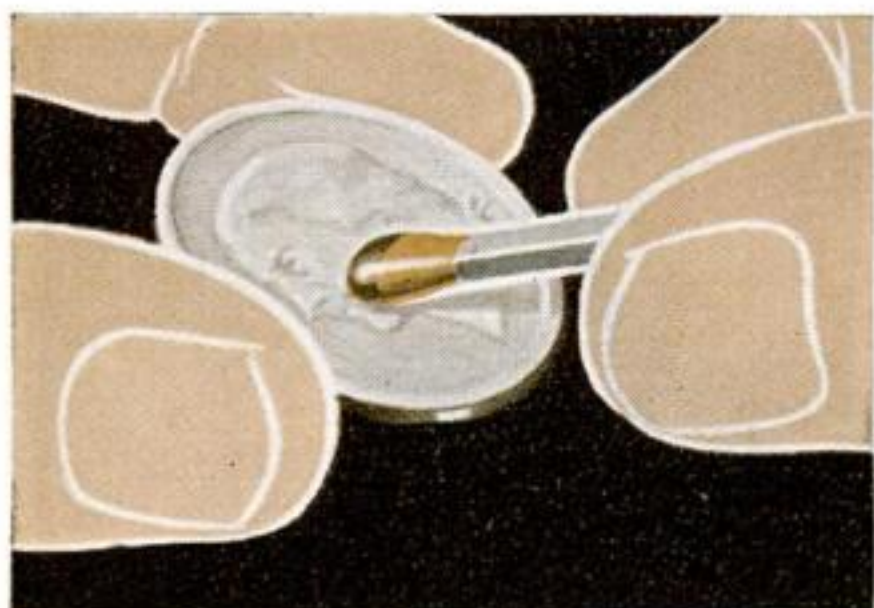
carbon black on a South Atlantic island might save Florida from a hurricane, because it acts as a trigger. It does not try to stand in the way of the hurricane forces; it merely upsets their already shaky balance.

Finding out where and when a small amount of energy will work as a trigger is the big problem, and one that cannot be solved today. It won't be solved tomorrow, either, for the electronic computer able to furnish the answer is not expected to be ready until 1949. Hail prevention appears much closer. END

## How to Make Snow at Home

ALL you need to make your own snow are a book of safety matches, a silver coin, a drop of iodine and some cold air in an enclosed space. A black background and a flashlight help, however, by making the tiny flakes visible. The procedure is shown below. For cold air, try any of the following: (1) the inside of a home freezer or a frozen-

food cabinet; (2) a big empty jar, chilled by packing dry ice around it in a bucket (*but don't touch the dry ice with bare hands!*); (3) the inside of a closed car, or a similar space, on a cold winter night. Blowing into the ice-cube section of a refrigerator won't work, because all the cold air spills out of it when the door is opened.



**1. Put a drop of iodine** on a match head and rub it on a quarter. Some silver will adhere to it.



**2. Strike the match.** When it burns, its smoke will contain microscopic silver iodide crystals.

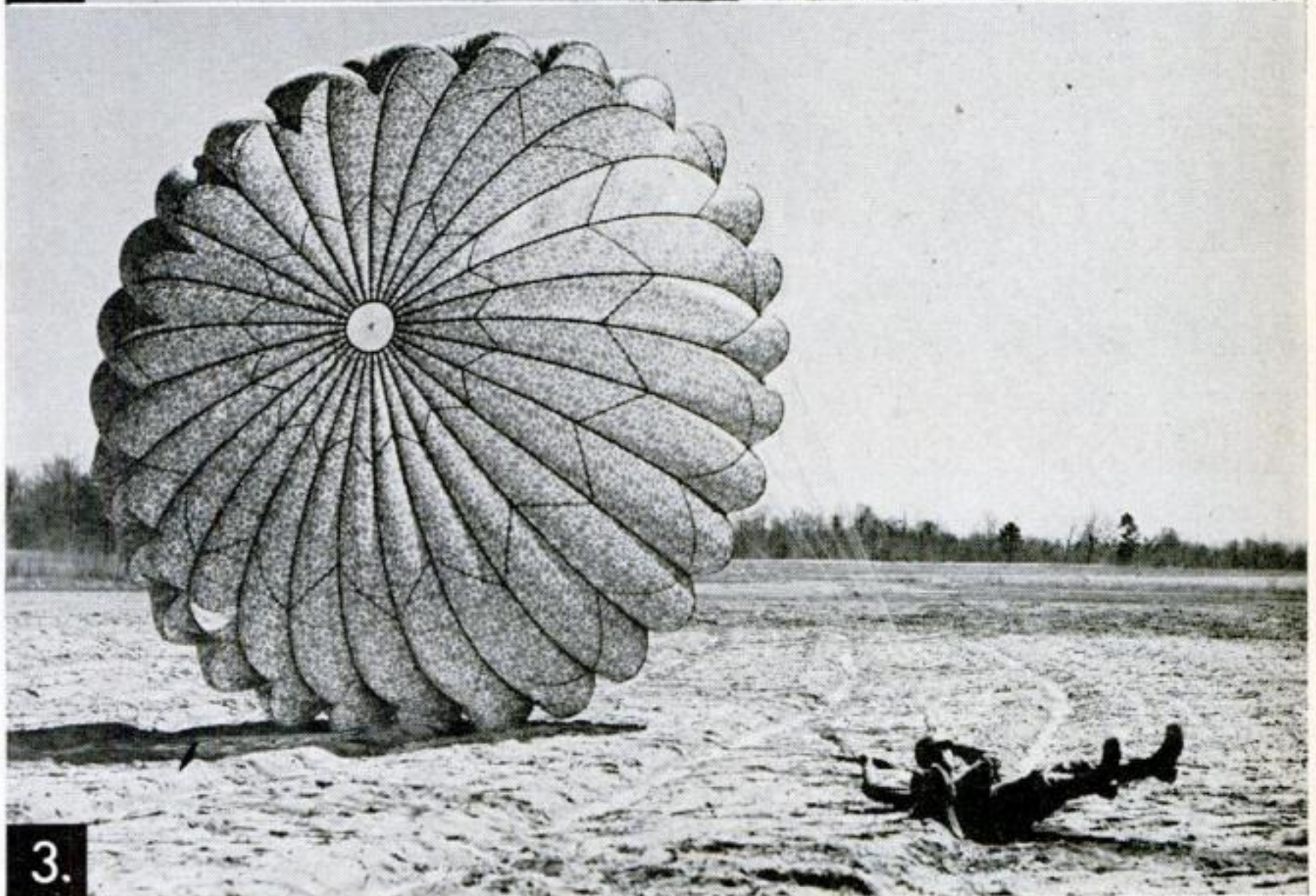


**3. Blow it out** in cold-air space (below 10° F.). Water vapor in your breath becomes supercooled.



**4. Vapor freezes** upon the silver iodide seeds, and a flashlight ray reveals shining snowflakes.



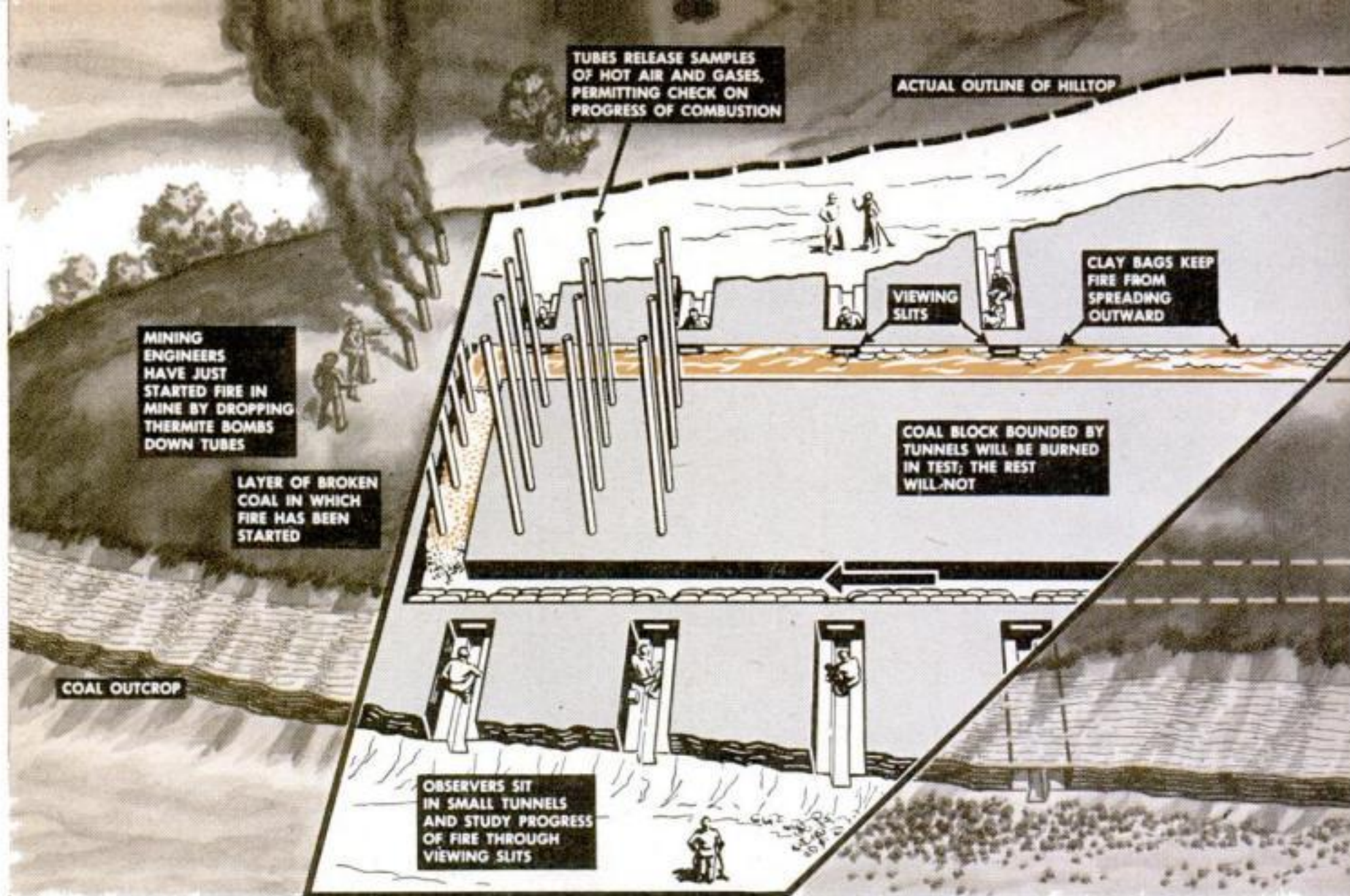


## One for the Books

A PARACHUTE landing as perfect as any illustrated in the textbooks is shown in these unusual pictures, taken recently during airborne training at Fort Benning, Ga.

JUNE 1947 89





This artist's conception illustrates the firing of a test mine similar to the one near Jasper, Ala.

# Minerless Mine Preburns Coal

**By Hartley E. Howe**

**D**OWN in the red Alabama hills, a wisp of dirty smoke over a claybank marks the birthplace of a revolution—a revolution in America's economy. If it succeeds, the coal miner may be released from his daily struggle with death in the dark. Industry may save the cost of hacking out and carrying bulk fuel. The city consumer may escape the rain of hundreds of thousands of tons of coal dust and ashes. And the United States may tap vast natural resources now wasted.

For no coal would leave a mine. It would be burned in the ground, where nature left it. Just as it was burned in Jasper, Ala.

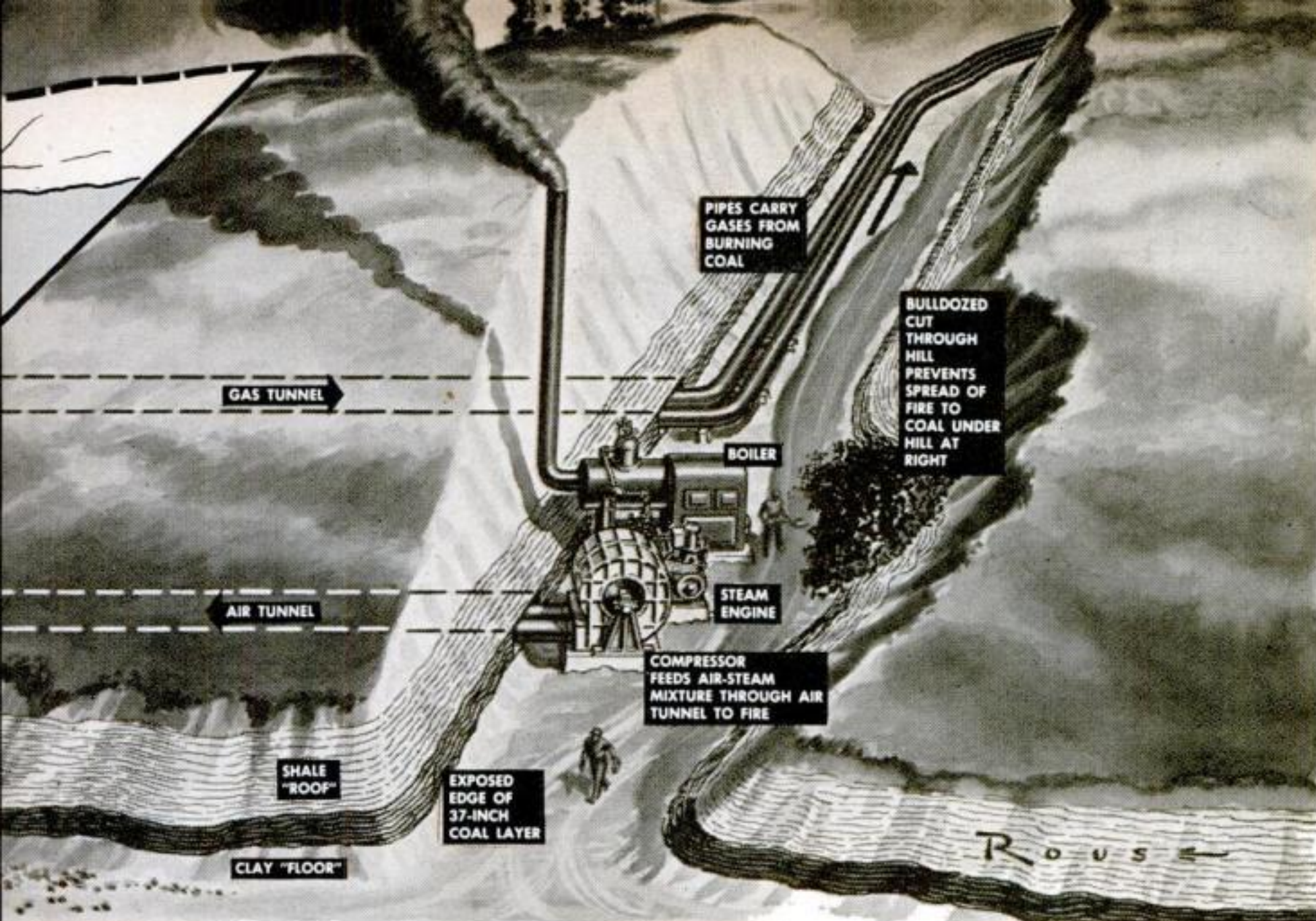
For there coal gas was made in the mine in a joint test by the Alabama Power Co. and the U. S. Bureau of Mines. A 400-foot spur containing a wide, three-foot seam of coal was isolated by bulldozing across its

base. From this cut a U-shaped tunnel was driven into the coal and the center section, about 150 by 40 feet, was fired.

To feed the flames, a blower pushed air or oxygen into one of the main tunnels. Sometimes live steam was used alternately with air, since this combines with carbon at a high temperature to produce the desired hydrogen and carbon monoxide. The resulting gases were forced out of the tunnel pipe at the other end of the U. The flames burned toward the source of needed oxygen, while clay bags kept them from spreading sideways.

The immediate goal is to find a way to use our huge deposits of coal so low in fuel value that they're not worth mining. But if successful, underground gasification may end all coal mining—and pay off in a big way. For cutting out, sorting and cleaning coal is dangerous and expensive, and to carry a ton from a West Virginia mine to New York City costs as much as to dig it.





Utilization of the coal gas is not shown. There are a variety of industrial applications possible.

The gas from a burning mine can be piped to the consumer or stored in tanks. It can be burned at the mine head to run steam generators, and sent to the consumer as electric power. It can be put directly to work spinning gas turbines. Or the gas might not be burned at all, but used as a raw material for the extraction of high-octane gasoline, lubricating and Diesel oils, and synthetic alcohols.

But all this is a good way ahead. Gas from the Jasper mine—a low grade—was used only for testing. Much has been learned since the fire was quenched and bulldozers scraped away the rock. Foreign experts—the Russians and Belgians have been working hard on the project—had claimed a level seam wouldn't burn as well as a tilted one. The level Jasper seam burned satisfactorily—virtually all the useful gases were forced out. Would the roof stay up long enough for the fire to get started? Would it fall, as desired, when it burned down so far that air could not be pushed in to keep it burning? It did hold up and it did fall, just right. Could the fire be controlled? No trouble at Jasper; when the flames began burning sideways after consuming the seam, water and steam were

pumped in and investigators were able to follow soon after. Will tar clog the pipes? It didn't at Jasper.

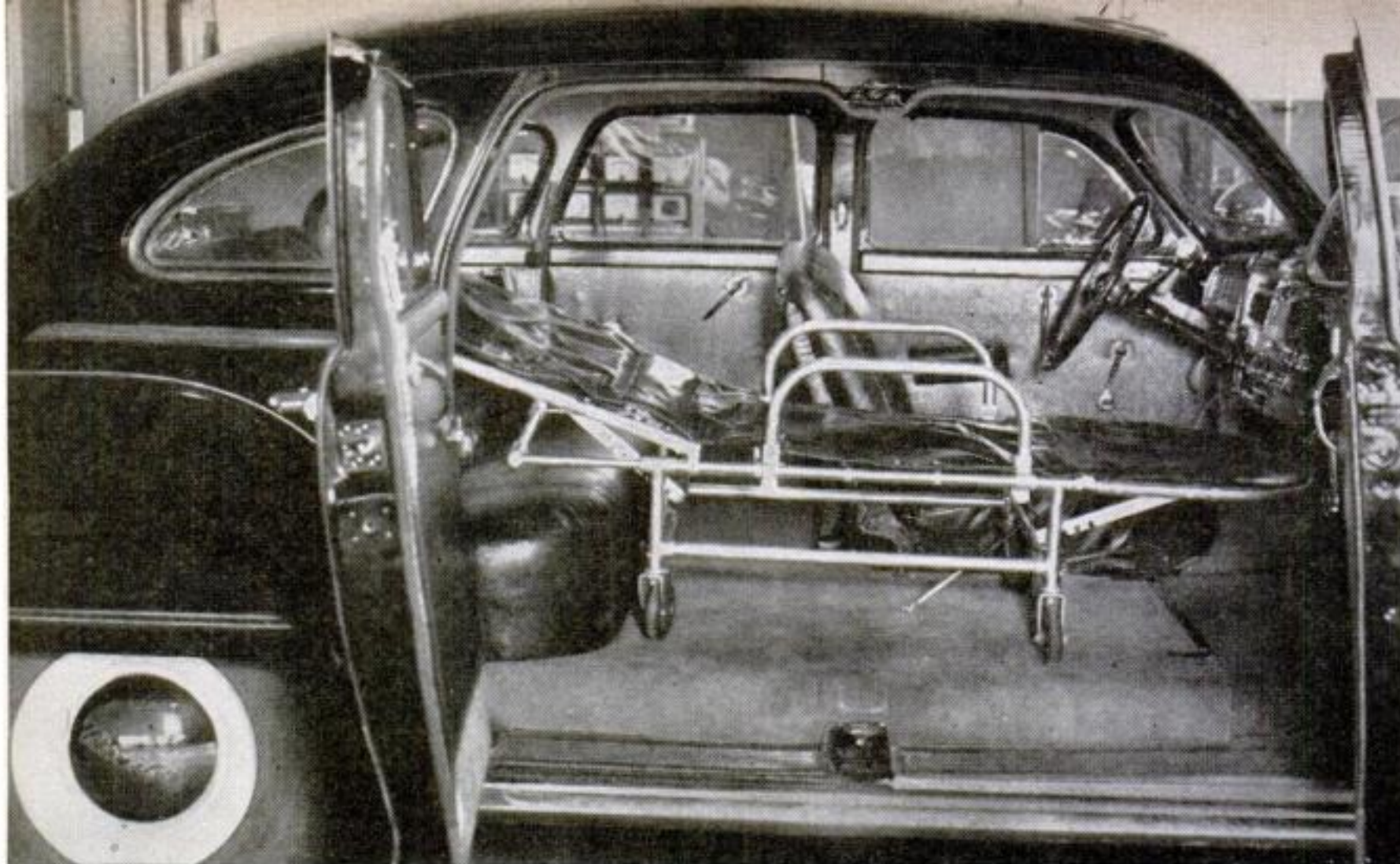
The Jasper test used the full-shaft method suggested many years ago by Sir William Ramsey. Costs might be cut further with the Ranney technique now employed in boring for coal or water. Shafts a few inches in diameter are drilled far underground but parallel to the surface. These would replace the expensive man-sized tunnels with a series of small combustion flues.

Jasper was the first in a two-year series of experiments. The next test is planned for a seam near an Alabama Power Co. plant, where gases can be piped in to run generators. Depths will be plumbed where greater air pressure can be used, although engineers will not be able to move in afterwards to check subsurface results.

Russia, with huge deposits of low-grade brown lignite, hopes to use the Ramsey process to heat the entire city of Moscow. And the present Five-year Plan calls for 33 billion cubic feet of gas to be produced annually through underground firing by 1950.

No wonder the fuel industries of America have their eyes fixed on Alabama. It may hold their future in its flaming depths. **END**

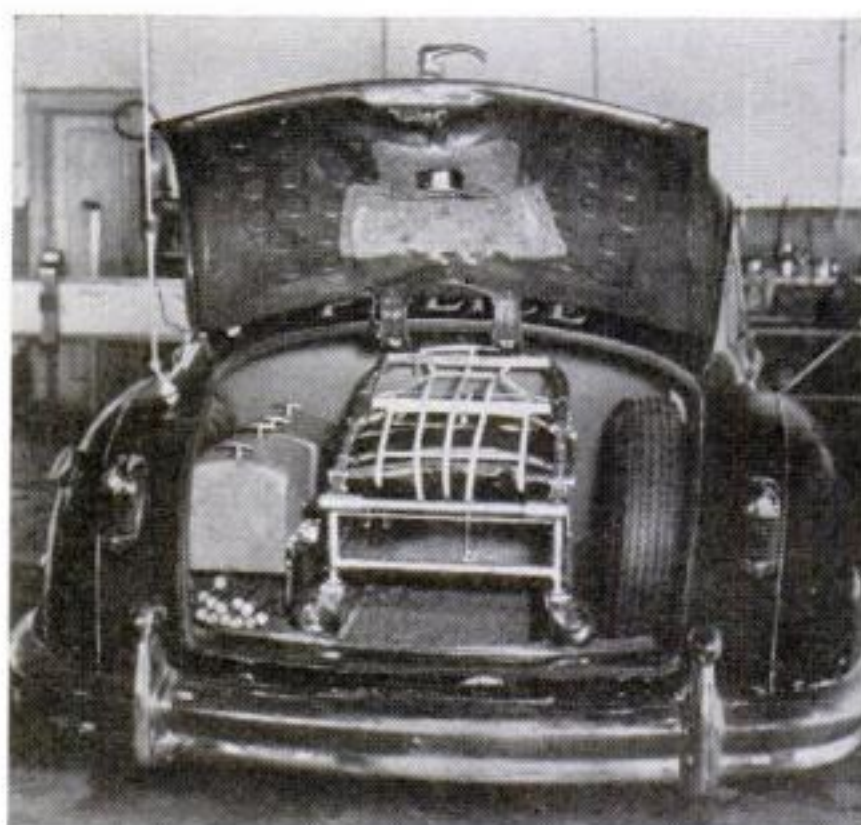




## Prowl Car Packs Bed

IN NO more time than you often spend waiting for a traffic light to change, this Illinois police car can be converted into an emergency ambulance.

A six-passenger sedan, it carries a collapsible stretcher in its trunk compartment. When used as an ambulance, the right half of the front seat is moved out and put in the trunk. The stretcher is unfolded and placed on the floor of the car, as shown above. Removal of the door post makes loading easy. Devised by the Chrysler-Plymouth dealers of Joliet, Ill., the conversion takes less than 90 seconds. The car is air-conditioned and carries radio and first-aid equipment.



## Electric Drum Timer

THE drummer of the Ward Island Military Band at Corpus Christi, Tex., is never out of step now. Complaints that the band marched too fast, too slow, or both, prompted him to devise an electric drum timer.

It consists of a square-wave multivibrator, batteries and a set of headphones. When the frequency of the oscillator is set at the proper marching tempo, the drummer finds it easy to stay in time and thereby keep the whole band that way, too.

Accused of thus substituting electronics for musical instinct, the band insists that it is simply supplementing musical instinct with electronics.



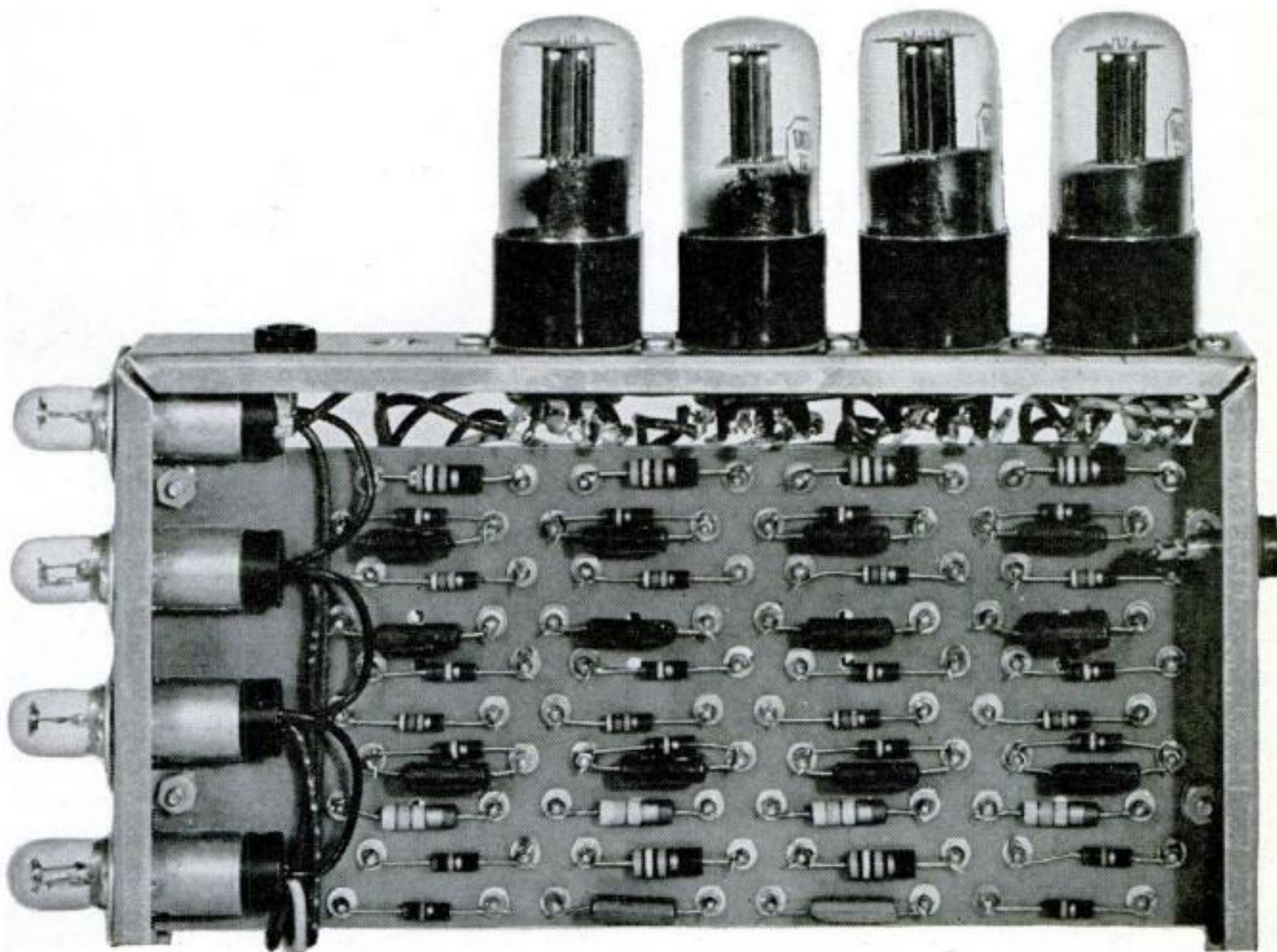
COUNT NO.	A	B	C	D
0	●	●	●	●
1	○	●	●	●
2	●	○	●	●
3	○	○	●	●
4	●	●	○	●
5	○	●	○	●
6	●	○	○	●
7	○	○	○	●
8	●	●	●	○
9	○	●	●	○
10	●	●	●	●

Diagram above shows how one unit of four lights can count to 10 with binary system. For zero, all four lights are off. Impulse one turns the first light on. Impulse two turns the first light off, second light on. Impulse three turns first light on again, leaves second light unchanged. Impulse four turns off both the first and second lights, turns third light on.

# Counting a Million a Second

**E**VER try counting to a million? If you're very fast and go without rest or food, you might do it in four days. But there's a machine that can count to a million in *one second*. It could count all of the 140,000,000 people in the U. S. in three minutes.

Now being used for all sorts of jobs, from counting microscopic jewelers' screws to totalizing parimutuel bets at a race track, this electronic device was originally developed by the Potter Instrument Co., of Flushing, N. Y., to measure the muzzle velocity of artillery shells (by gauging the time a shell takes to fly between two photoelectric cells). It is a big jump ahead of the best mechanical



Four neon lamps on this decade unit enable operator to read number of impulses as registered by counter.



counters, which have a top speed of only 10 per second, and completely eliminates the wasteful method of counting small items by weighing them out in batches.

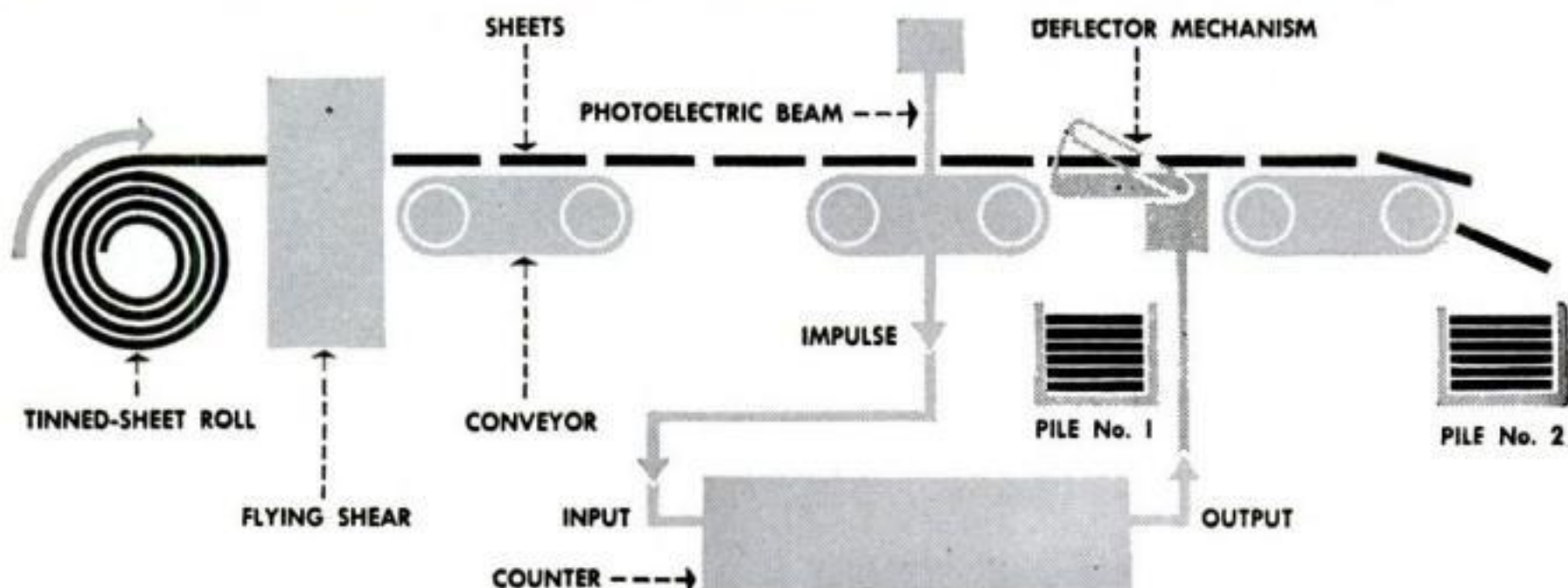
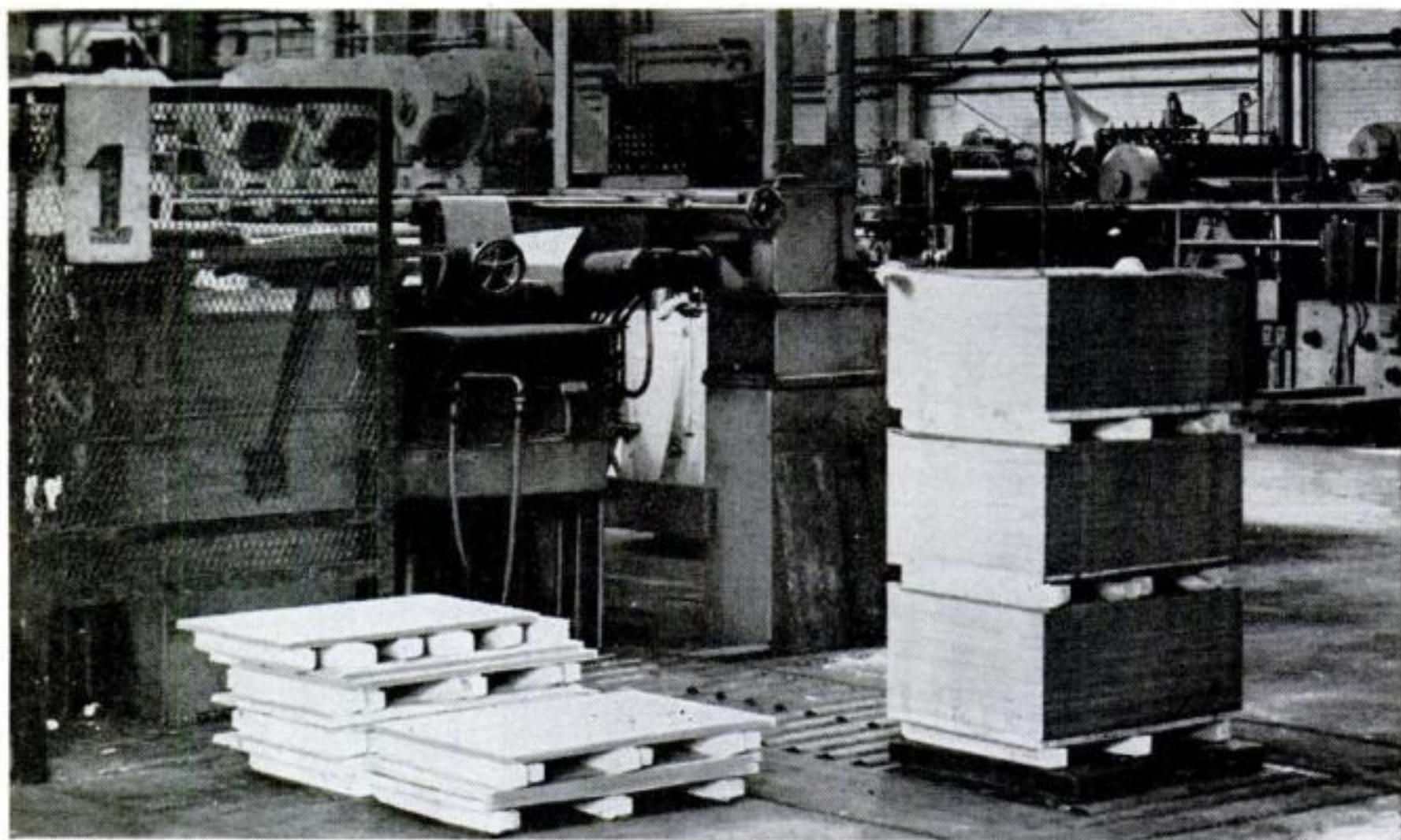
The basic element in this faster-than-human brain is the "decade," a unit tallying up to 10. Any total count can be obtained by hooking together enough decades.

Commercial models like one that tallies sheets of tin-plated steel have four decades and can count as high as 10,000. These machines are designed for only a fraction of the million-per-second speed attainable—usually about 250 per second. In the steel sheet counter, the sheets ride on a conveyor belt past a photoelectric cell and fall into a container. Pills, screws, bottle caps, or

safety pins are counted in a similar fashion.

The Potter counter, like the ENIAC and RCA electronic computers, uses the binary system of counting by twos. Essentially it consists of a series of electronic switches (dual triode vacuum tubes) that turn small neon lights alternately off and on. Each successive electric impulse turns a switch (and its light) on if it was off and off if it was on. The impulse stops when it turns a switch on, keeps going to the next switch when it turns one off.

With this system, four switches could count up to 15. Each decade in a Potter counter has four switches, but is wired to stop at nine. The tenth impulse sets it back to zero and starts the next decade. **END**



One application of the high-speed electronic counter is the automatic piling of tin-plated steel sheets. The diagram shows how this particular set-up provides stacks containing exactly the desired

number of sheets. Although machine can count 10,000 sheets, piles of 100 can be handled by adjusting mechanism to start counting at 9,900. Quantity is selected by means of dial switches.

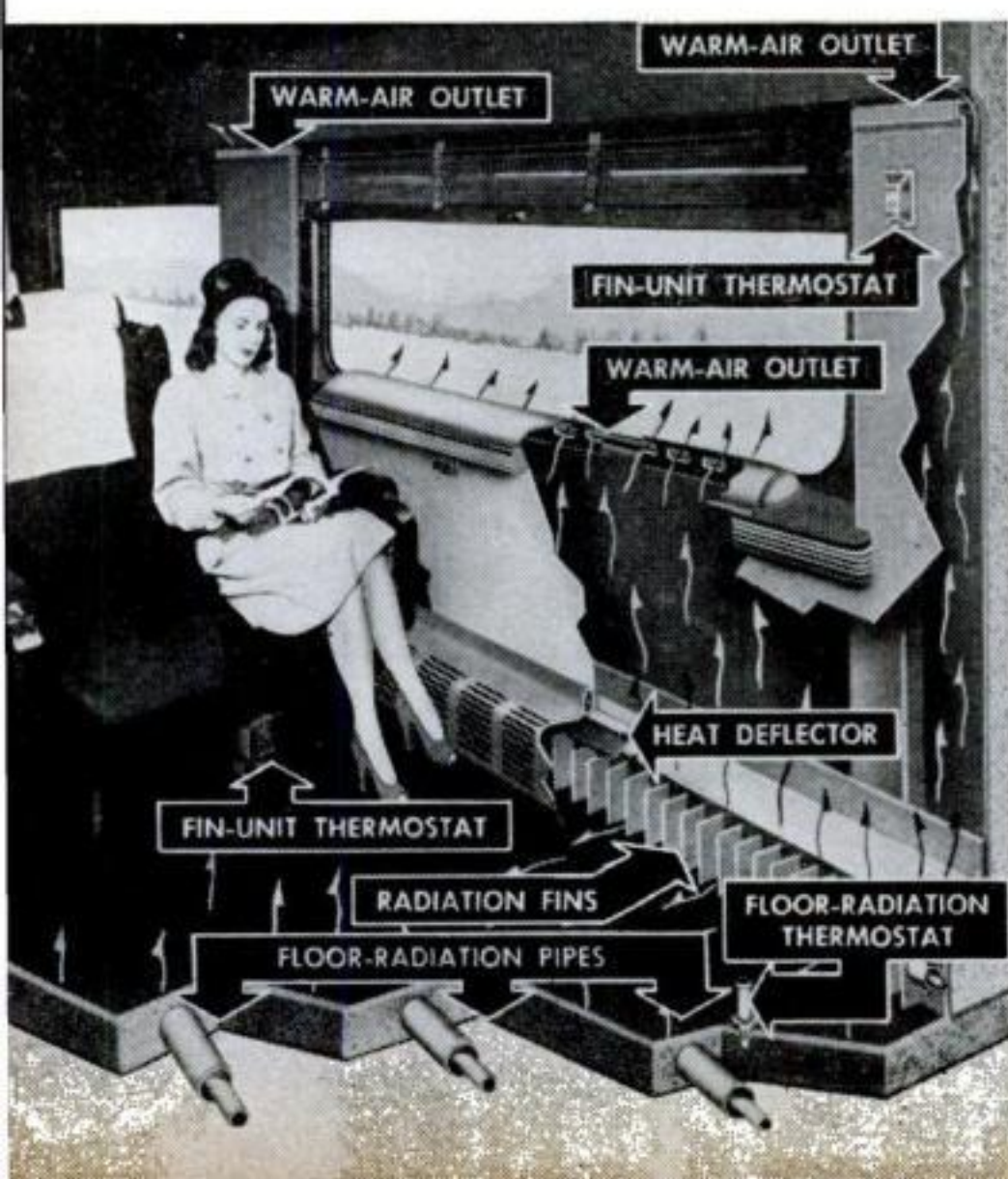




## Giant Plow "Plants" Telephone Cable

THIS giant ditchdigger literally plows cable into the ground in a single operation. Used for the first time in laying the initial sections of a coaxial telephone cable that will eventually span the continent, the 27-ton

monster (bottom photo) can rout out a ditch up to five feet in depth. Drawn by two or more 20-ton tractors (top photo), depending on soil conditions, its plowshare feeds the cable into the furrow it cuts.



## Two-way Heat Tested In Railroad Cars

EVEN and controlled heating at all times is the object of a heat-modulation system now being tested in railroad cars.

Principal source of heat in the new technique, called Rador, is a finned tube at the base of each wall. Steam, fed through an inner pipe at one end, is let into this tube at the other, condensing as it flows back and liberating heat through the fins.

Part of this heat is then discharged through wall ducts, above and below the window, and the rest at floor level. Finless floor units supply additional heat. Zoned thermostats keep a close control on the temperature at various points throughout the car.



STARTER MOTOR

AIR COMPRESSOR

INTAKE PORTS

DETACHABLE PUSH-IN  
DEFLECTOR VANE BOX

OIL FILLER SPOUT

TACHOMETER GENERATOR

VACUUM PUMP

GEAR TRAINS  
FOR AUXILIARIES

GEAR BOX DRIVEN OFF  
IMPELLER, DRIVING TOP  
AND BOTTOM AUXILIARIES

SPINNER

CENTRAL INTAKE

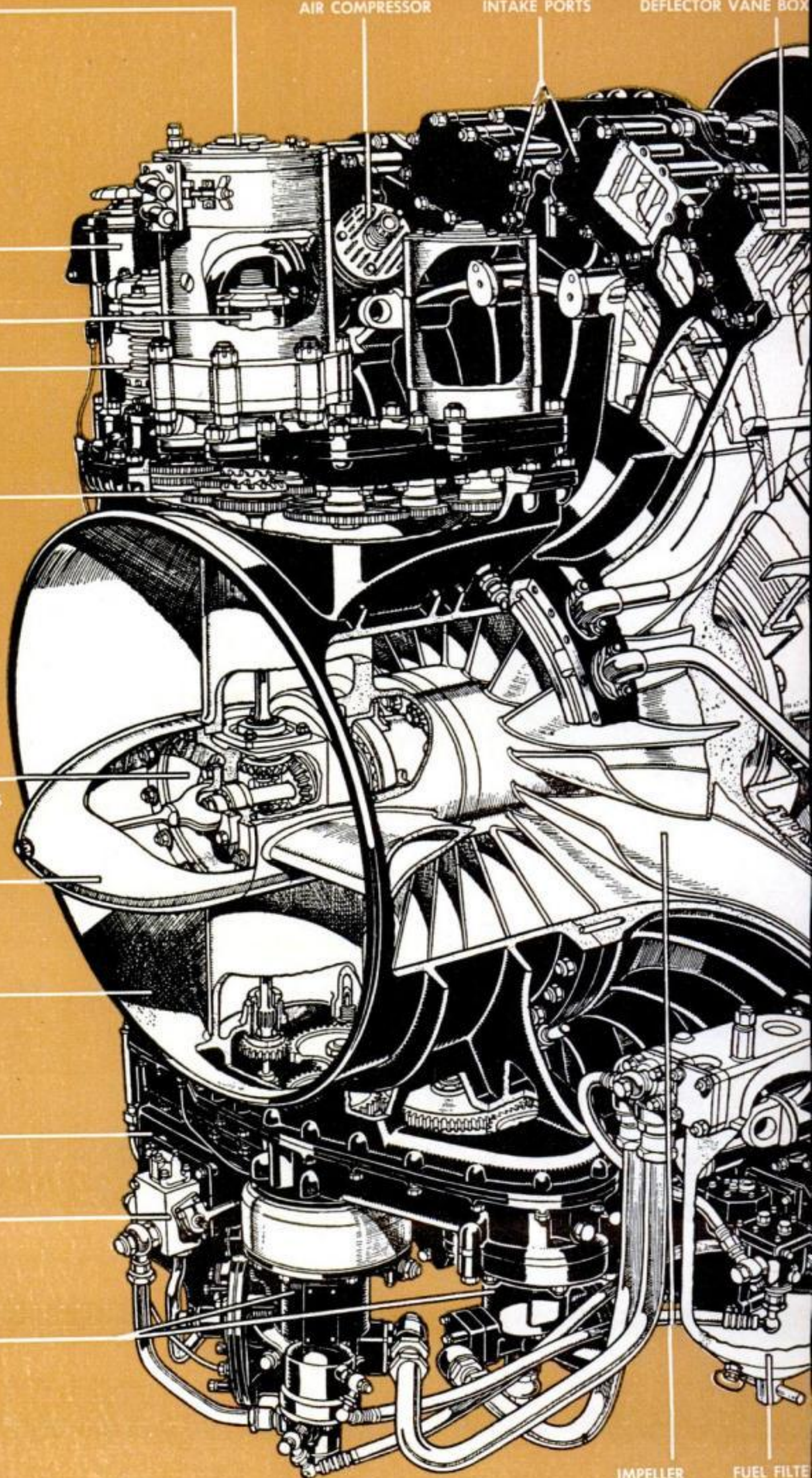
OIL SUMP

FUEL THROTTLE

FUEL PUMPS

IMPELLER

FUEL FILTER





TWIN ENTRY TO  
COMBUSTION CHAMBER

TEN COMBUSTION  
CHAMBER UNITS

STARTER UNIT

# The "Ghost" Goes to Work

JET TUBE

REACTION  
CONE  
("BULLET")

PRIMARY AND SECONDARY  
AIR FLOWS BETWEEN  
COMBUSTION CHAMBERS

SUPPLY RING WITH  
BRANCH PIPES TO BURNERS

PROPELLER-TO-TURBINE SHAFT

**F**OUR years after design was begun on its prototype, the British De Havilland Ghost is finally going to work. Developing a thrust of 5,000 pounds to rate as one of the world's most powerful jets, it is being installed on both the Lancastrian and the Vampire. The Ghost is adaptable to many types of aircraft. Its power, at 600 m.p.h. at sea level, corresponds to 12,000 horsepower from a reciprocating engine driving a propeller.



For long-range and endurance trials, Ghost jets are being put in Avro Lancastrian's outboard nacelles.

CUTAWAY COURTESY THE AEROPLANE, ENGLAND

JUNE 1947 97



# Radar Clocks the Traffic



A Connecticut state policeman, running a test for PSM, clocks a car on the Merritt Parkway. With the

meter in plain view, motorists were suspicious; all slowed down. Arrow indicates bounced signal.



Indicator, one of the meter's three compact units, has a range from zero to 100 m.p.h. The needle holds a position on the dial long enough for an accurate reading to be taken, visually or electrically.



The transmitter-receiver contains an oscillator and generates 1/10 watt at 2,455 mc. At its maximum operating distance, about 150 feet, the transmitter sprays microwaves in a pattern 30 feet wide.



**You may not see the little black box beside the road, but its microwaves will tell just how fast you're going.**

**By Devon Francis**

**I**F YOU spot a highway patrolman hovering over a little black box alongside the road the next time you go motoring, it may mean your car is being clocked by radar. But you may not be able to spot the box or the cop—the apparatus is so compact that a bush will hide it, and it can be manipulated by remote control.

The Electro-Matic Speed Meter is something new and versatile in speed measurement. With it, maximum safe speeds on U. S. highways can be determined. It can tell, too, just how fast a railroad train can take a curve of any given radius.

Heretofore, it has been necessary to stretch wires or tubes across a highway to clock the speed of a car. The elapsed time between two points was obtained by stop watch or electronically, and the speed was read from a conversion chart. A variation of the system was the use of "electric eyes."

#### ***Microwaves Do the Work***

The Speed Meter, developed and manufactured by the Automatic Signal Division, Eastern Industries, Inc., of East Norwalk, Conn., shoots microwaves at an oncoming or retreating car, and the speed is read directly off a dial.

In its timing, the device works on the principle that a radio wave reflected from a moving target will cause a shift in the re-

flected wave length proportional to the speed of the target. This shift is shown on the meter in miles per hour.

The meter was designed primarily as a highway engineer's tool. An obvious application is in determining safe speeds on the hundreds of thousands of curves on highways, and at intersections. Test cars equipped with airplane ball-and-bank indicators, already in use by many state highway organizations, can be clocked for maximum safe speeds. Here the meter is invaluable because it is accurate within two percent of a true speed, while auto speedometers may err as much as 15 m.p.h. on the high side in the higher speed ranges.

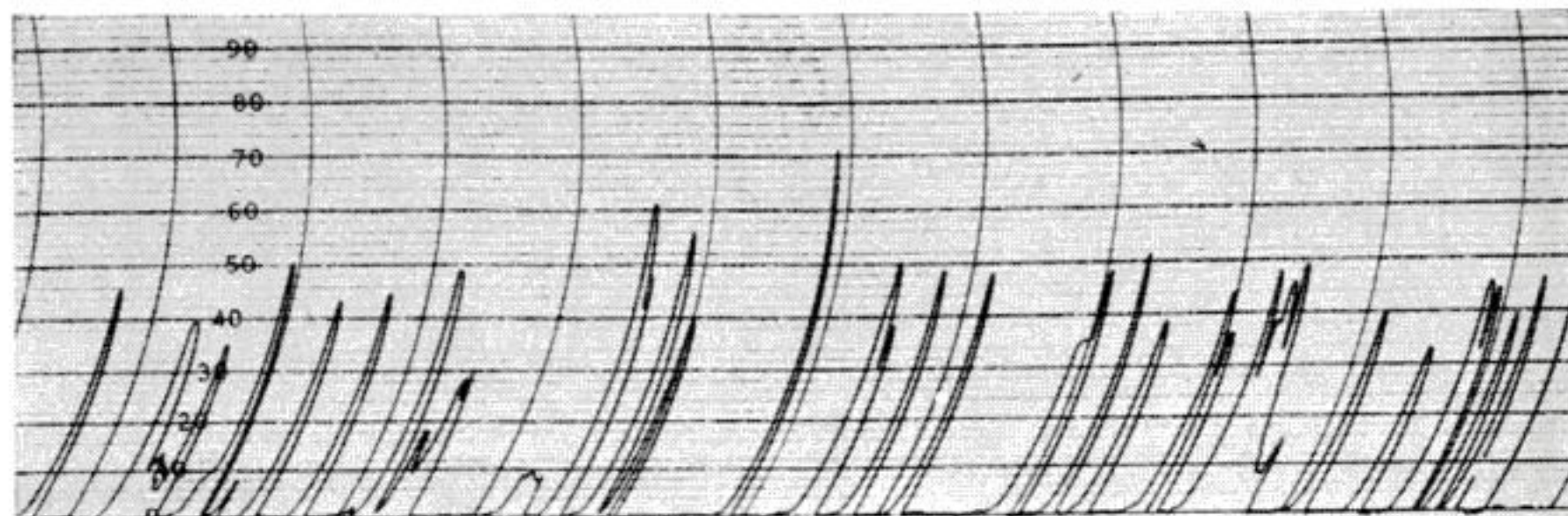
#### ***Court Approval a Question***

The meter also could be used to catch speeders, although the manufacturer does not emphasize that. It has not yet been determined whether a traffic court would accept such microwave evidence.

The meter can be built to measure aircraft speeds, too, up to 1,000 m.p.h. or more, but its margin of error would introduce a possible inaccuracy of 20 m.p.h.

Using it requires little or no practice, but an operator must realize that his dial will register on the biggest target or the fastest car in heavy traffic. Practical application led to desensitizing the microwave pickup. Experimental models gave readings on cars a half mile away as well as those near by. The needle on the dial went crazy.

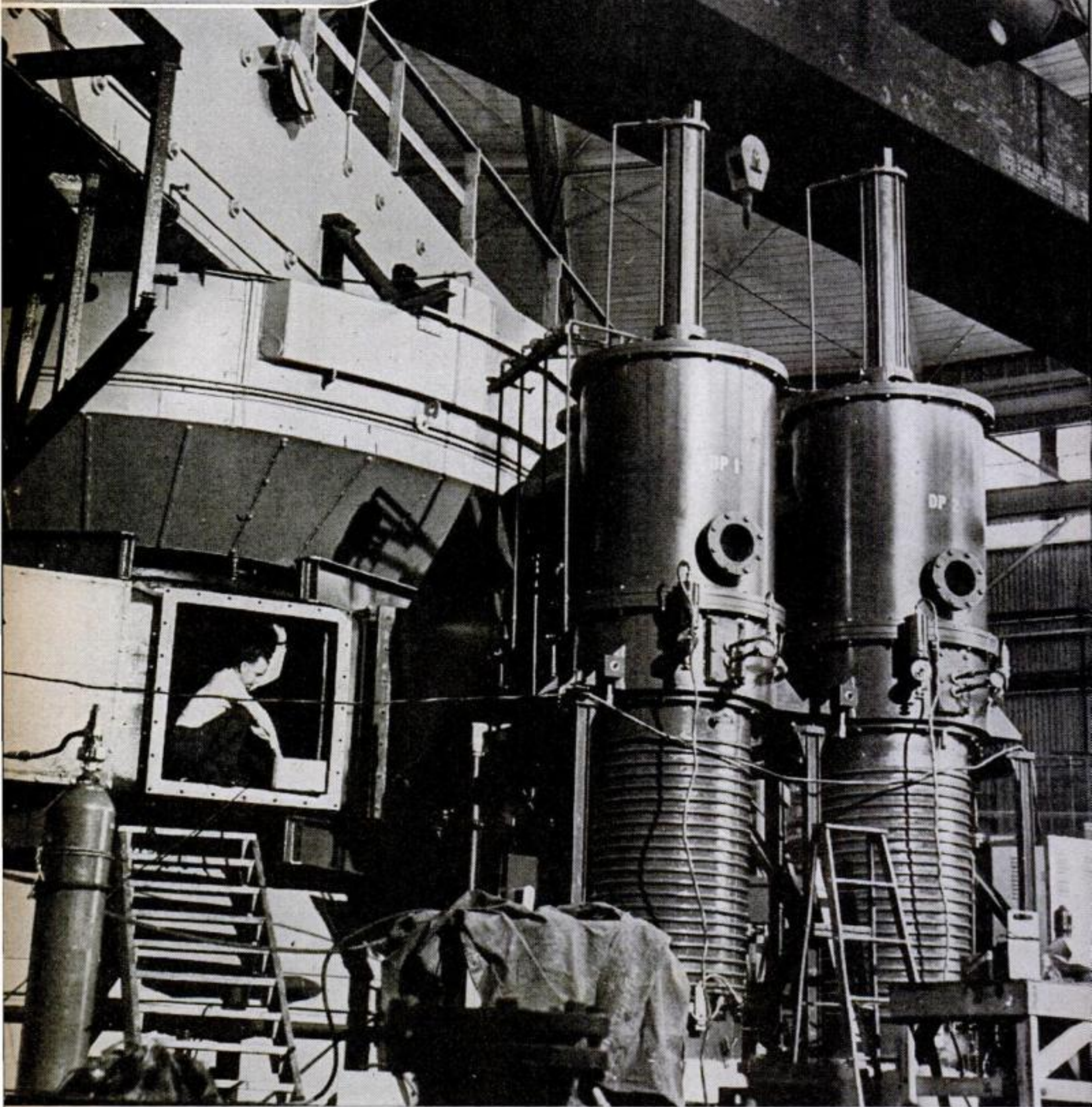
The meter has been undergoing tests for several months with the co-operation of Connecticut's Commissioners of State Police, Highways and Motor Vehicles. **END**  
*PSM photos by W. W. Morris*



A permanent record of highway speeds can be obtained by transmitting the dial reading to a graphic recorder. Fluctuations during test show how needle repeatedly shot from zero to a car's speed; 70

m.p.h. reading in center was made by a state police car. One man can operate the speed meter, which weighs only 45 pounds complete. An FCC license is required, but not an operator's license.

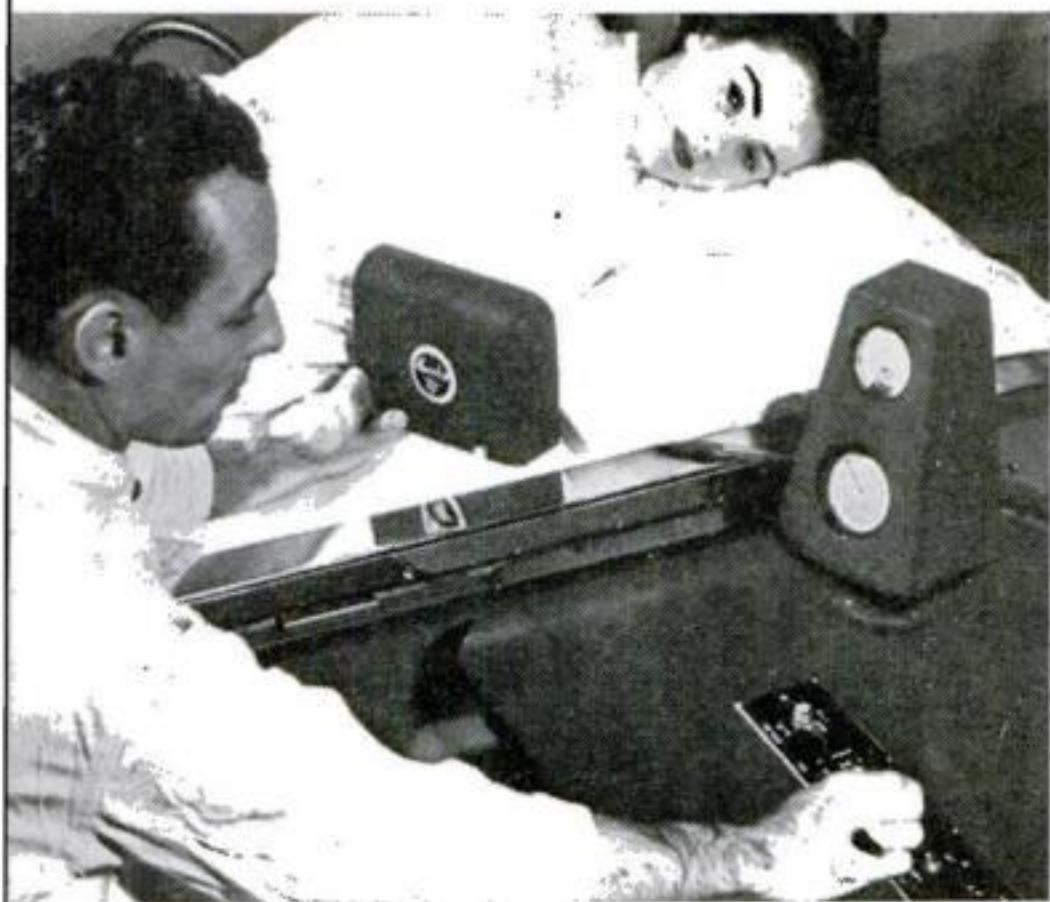




**Spearhead of Research.** The first 200,000,000-electron-volt deuterons ever made by man have been produced by this 184-inch cyclotron at the University of California, shown undergoing repairs. The technician at lower left is working inside the

vacuum acceleration chamber, between the giant magnet's poles, while the crane operator at upper right maneuvers his hook into position. The two huge cylinders on the right of the acceleration chamber are the cyclotron's high-vacuum diffusion pumps.

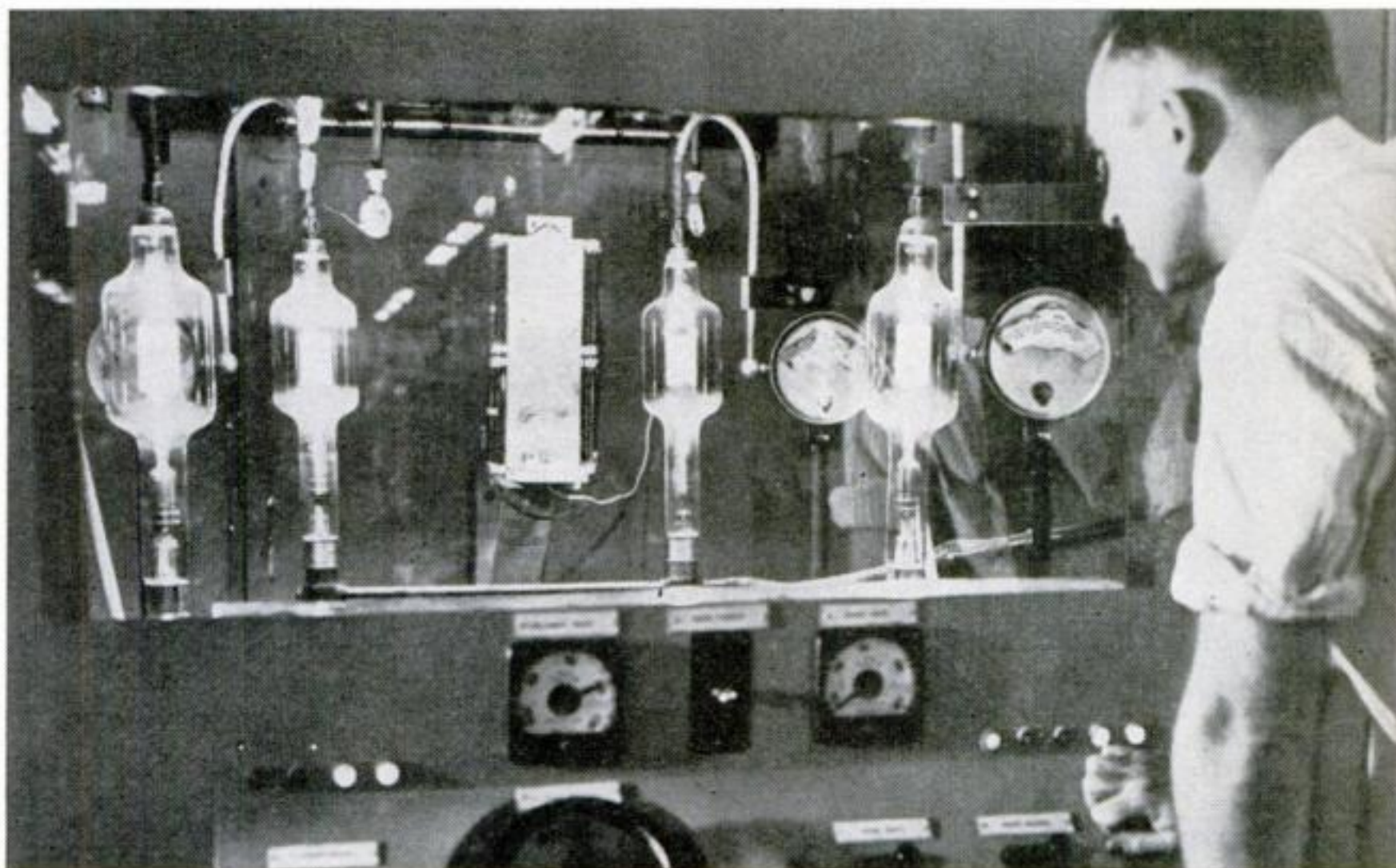




**Tracers Trailed.** Here Geiger counter tracks radioactive elements in patient on X-ray table. Doctors hope to find how cells of cancerous tissue form by following substances the body uses. Nearly any substance can now be made radioactive.



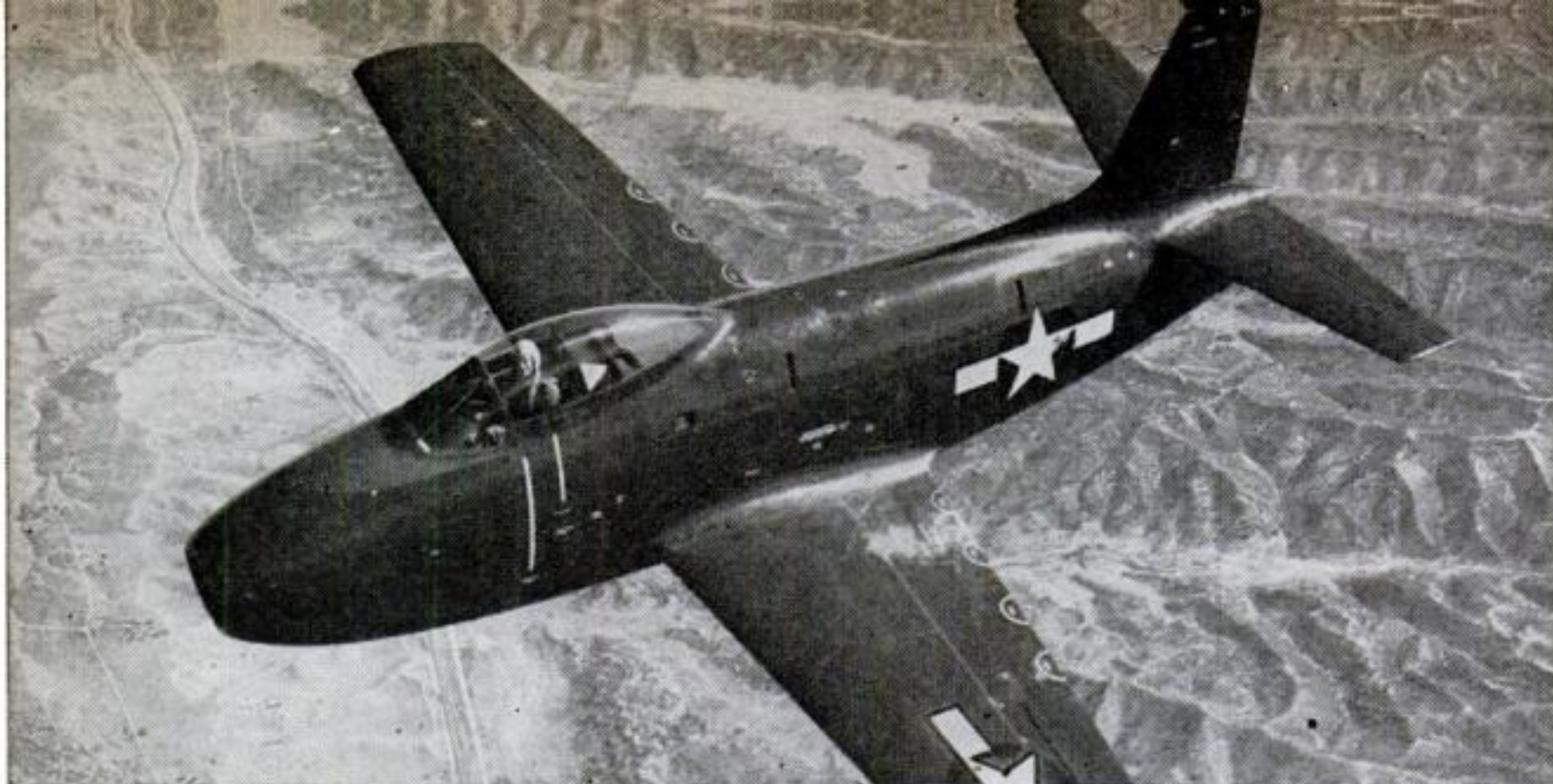
**Looking into Steel.** The internal structure of steel can be similarly checked by tracing radioactive carbon. This researcher is using a counter and photographic plate. Movement of carbon through steel is believed to make metal "age," grow brittle.



**Uranium Catchers.** These high-voltage kenotron tubes, shown under test at the General Electric plant in Schenectady, N.Y., play an important part in the development of atomic energy. They are used in the electromagnetic plant at Oak Ridge, Tenn., for

the concentration of uranium. Kenotrons also have many industrial applications, such as the electrostatic precipitation techniques used for dust collection, gasoline cracking, painting and enameling, and in the manufacture of sandpaper and textiles.





**Navy's Fastest Fighter.** A new GE jet gives North American's FJ-1 better than 500 m.p.h. to make it the Navy's fastest

fighter—and the only U. S. one with a straight ram duct in the nose. Built for carriers, its range equals present types.



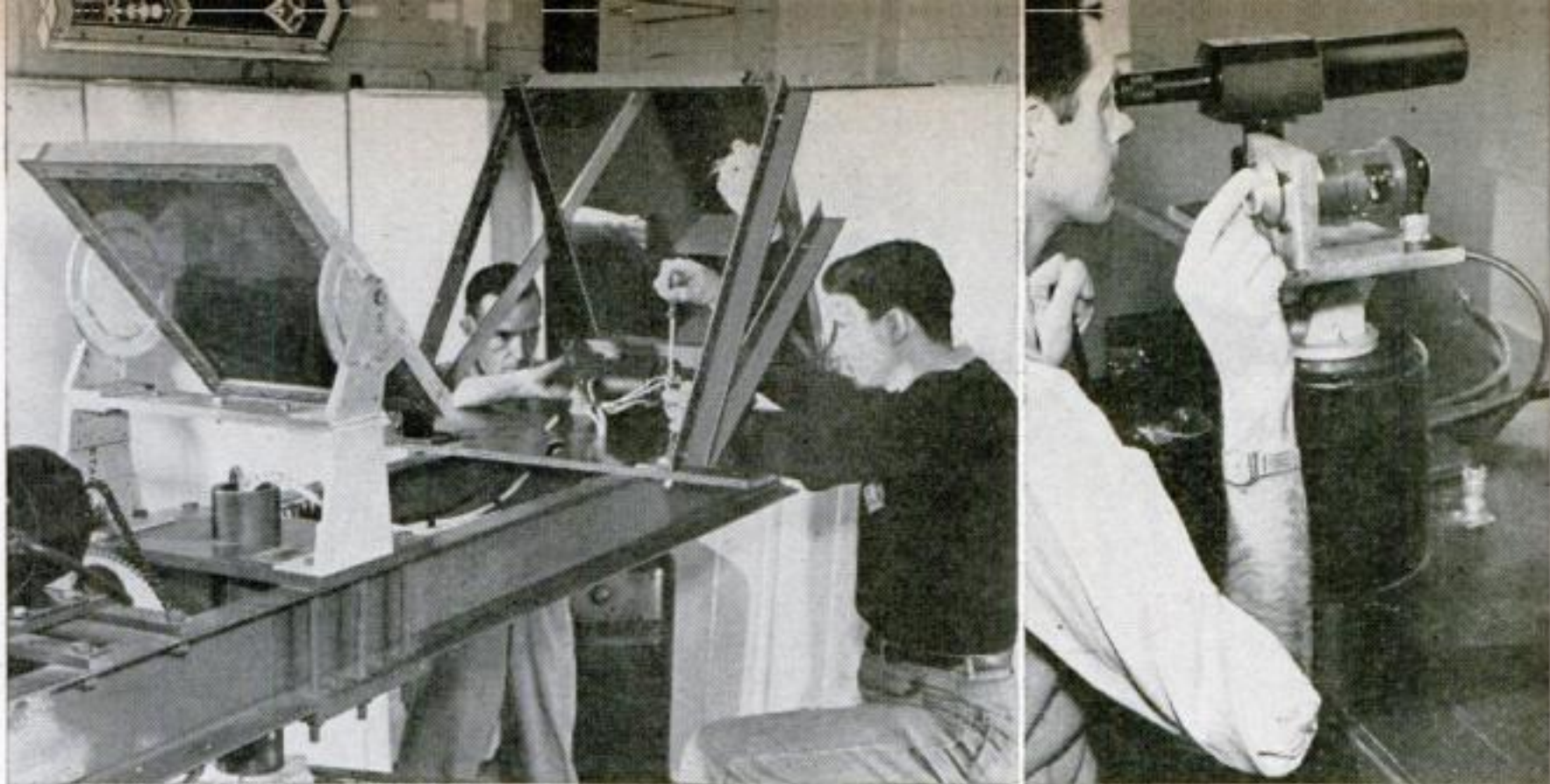
**Service Station on Wheels.** This mobile fuel servicing unit for large airports pumps its gas through hydrant valve connections of an underground pipe line. A hydraulic hoist lifts the fueling crew and hoses on a four-foot-square platform to any height up to 15 feet. The servicer is self-propelled and can deliver 150 gallons a minute through each of its two hoses. Lubricating oil is carried in a 200-gallon container, and a compartment is provided for storing hydraulic oils, greases and other special products for the maintenance of aircraft.



**Flying Lightweight.** Weighing only 1,050 lb. with full tanks, Thorp Aircraft's two-place Sky Scooter cruises at 100 m.p.h.,

has a 400-mile range. Powered by a 65-hp. Continental engine, it is 18 feet long and its wing span is 25 feet.





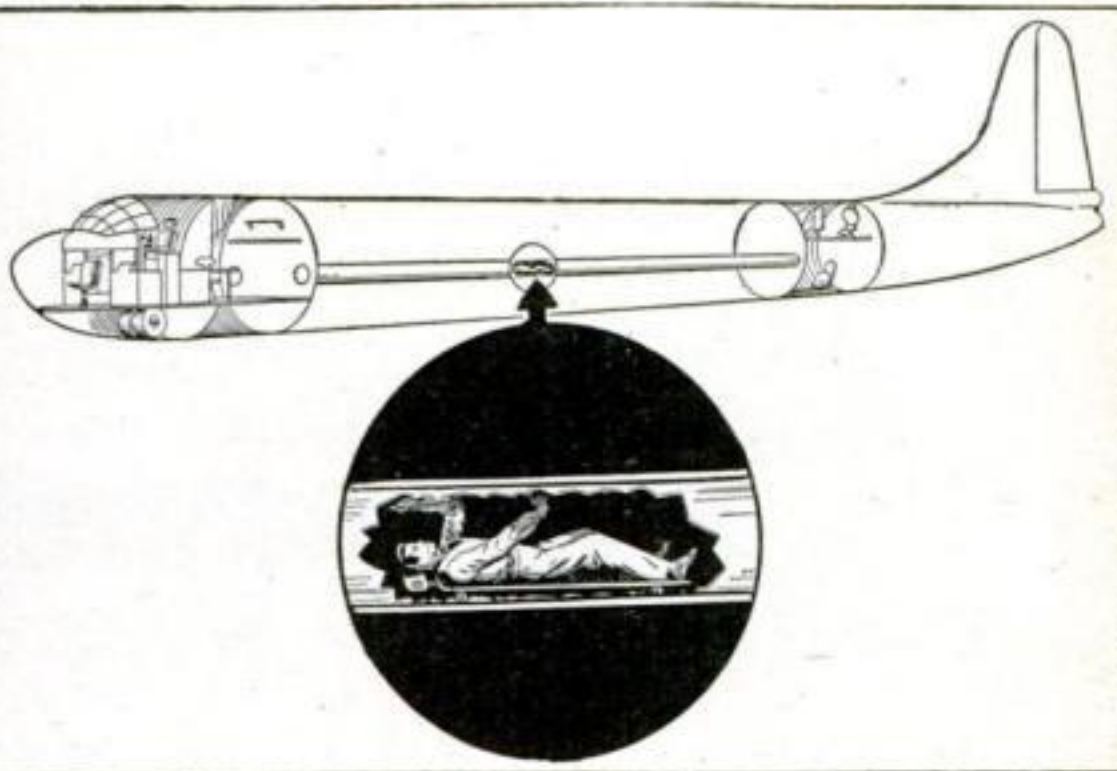
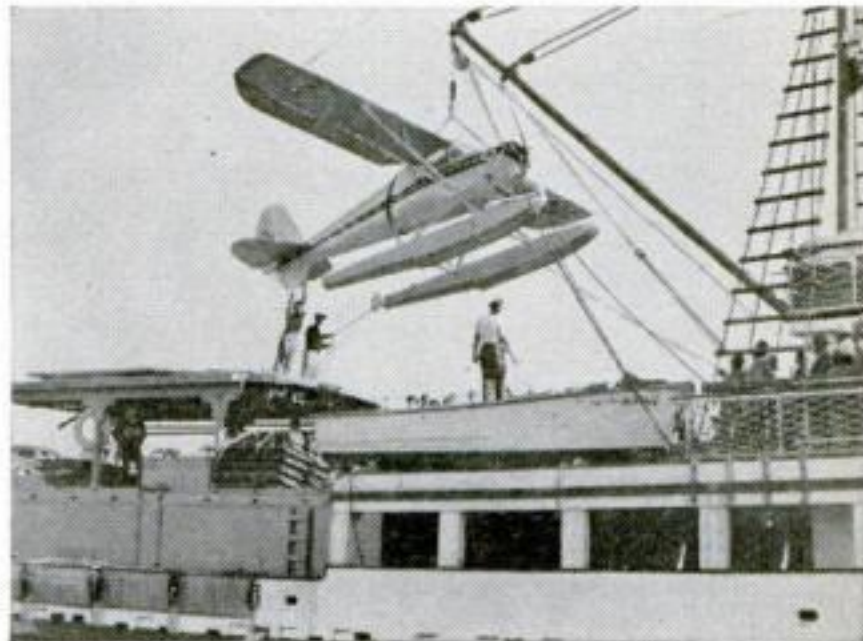
**Motor Merry-go-round.** A whirl at 200 r.p.m. in this centrifuge gives a small motor a workout at 50 G. Mirrors reflect

the motor's image back to center and eventually to the telescope, at right, synchronized so motor appears to stand still for study.

## WHAT'S NEW in AVIATION



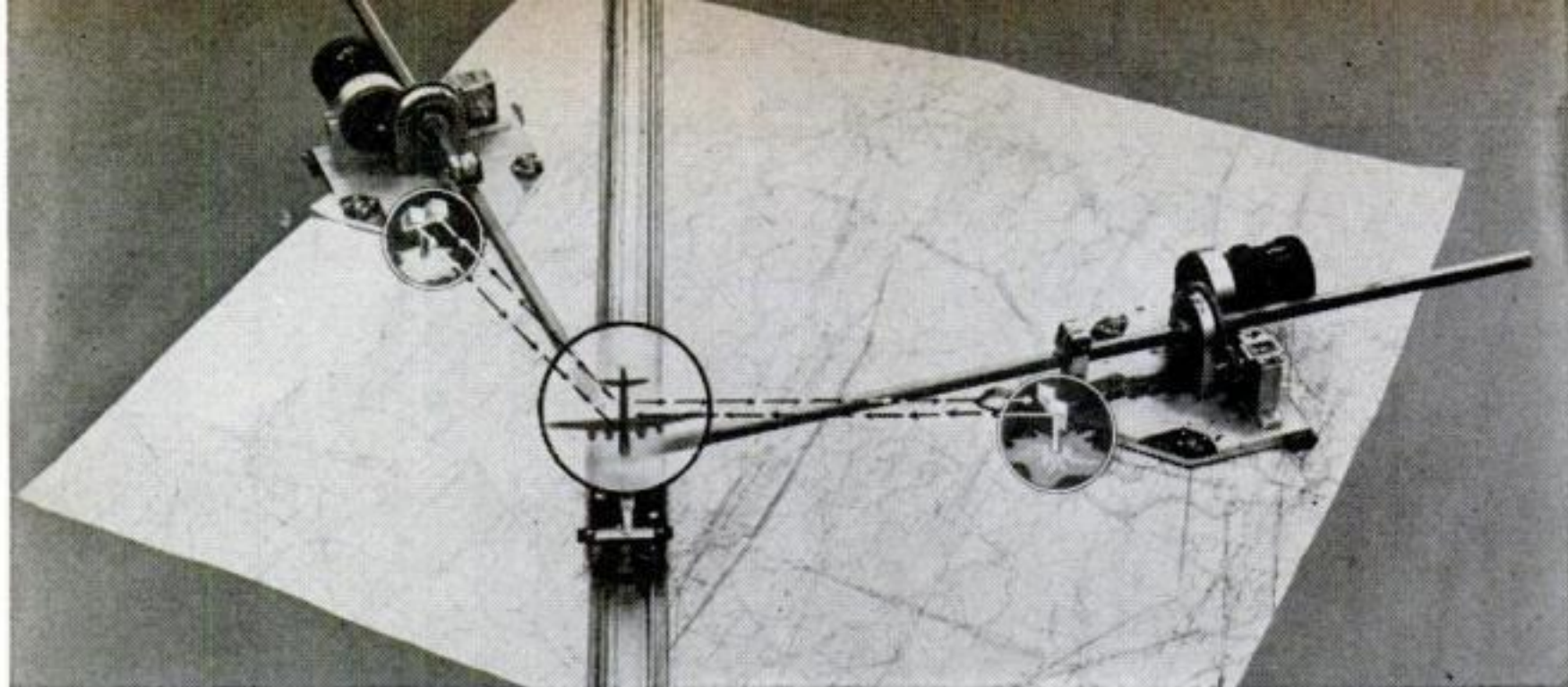
**Finding Fish by Air.** Air-minded Southern California fishermen are using a Luscombe monoplane to find more tuna quicker. Fitted with floats, the plane rides to the fishing grounds in the boat's bait tank and is boom-lowered into the water.



**Flying Subway.** A miniature 85-foot "subway" is the only connection between the forward and aft cabins of the AAF's

giant B-36. Lying on his back on a four-wheel scooter, a crew member must pull himself through the tunnel by a cable.





### On the Straight and Narrow.

This shoran indicator, used for mapping, helps keep a plane within 250 feet of the proper ground track. Radio pulses are sent to two fixed points; echo times give dis-

tances, translated into length of two geared rods. Where these cross, a pointer marks plane's position and moves along desired course. If plane drift off, one rod shortens, pulls off pointer, and a dial needle moves.

## WHAT'S NEW in AVIATION



**Periscope Avigation.** A new combined periscope-sextant may eliminate the astrodome used by air navigators. The observer stays within the cabin; only 1½ inches of the instrument protrudes. Dome removal would end chance of collapse, cut down drag and simplify sighting. Square D Co. developed the sextant for the Army.



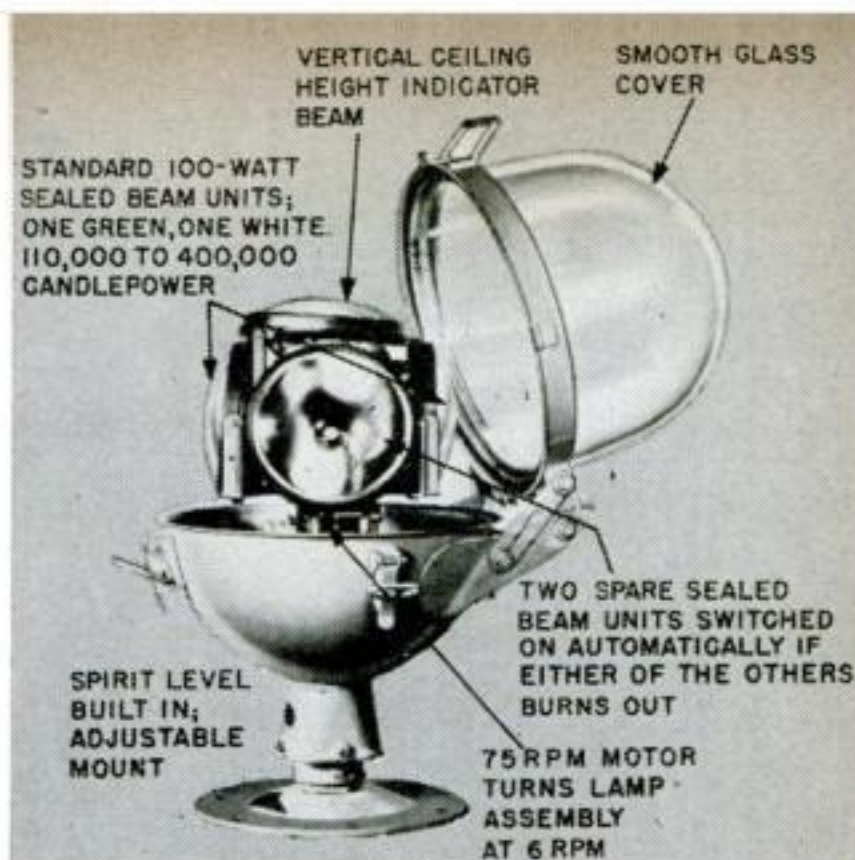
**In the Air Again.** Howard Hughes is at the controls of this XF-11 photo plane, a duplicate of the one in which he narrowly escaped death when it crashed last July.

The XF-11, designed for the Army Air Forces, is intended for high-speed, very long range photographic reconnaissance. Here Hughes is testing it at 6,000 feet.





**Bump Speeds Air Flow.** A two-foot-thick aluminum bump, installed in a wind tunnel by Lockheed engineers, speeds air flowing around models by 150 m.p.h., permits tests at velocities up to 850 m.p.h.



**Lightweight Beacon.** Designed to meet the requirements of small airports, this low-cost rotating beacon is easily installed on poles or roof-tops. It is made by the Line Material Company.

**Light Analyzes Clouds.** Used at Army and Navy airfields to measure cloud heights and relative densities automatically, 125 ceilometers like the one pictured at right are being manufactured by General Electric. A pulsating light device throws a vertical beam into the sky to scan the clouds. A detector unit, placed 1,000 feet from the projector, records the "scatter energy" of cloud layers dense enough to reflect and scatter the beam, and gives accurate information on the distance between cloud banks and the ground. Both height and density readings are transmitted to an automatic recording device.



**Six-Jet Giant.** Now undergoing tests for the AAF, Martin's six-jet XB-48 is the largest craft of its type yet built. It has a span of 108 feet 4 inches and is 85 feet

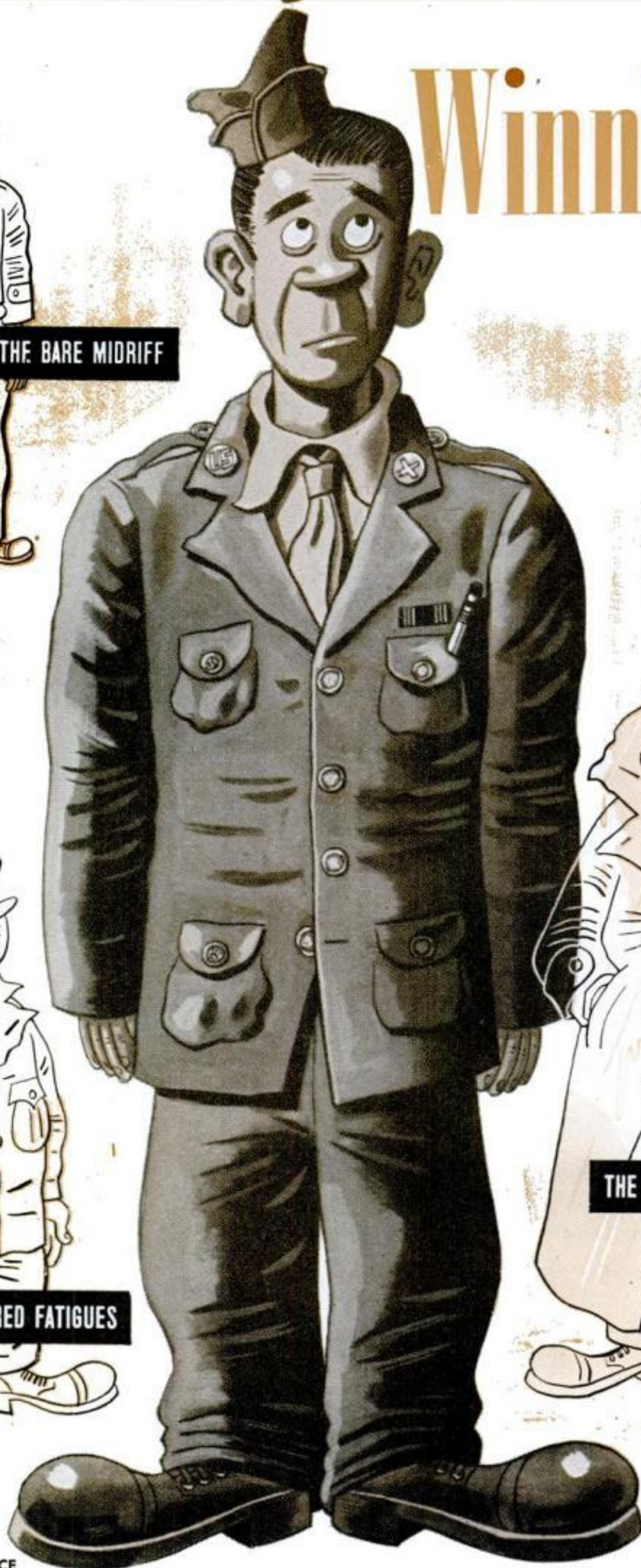
9 inches long. "Bicycle" main landing wheels, set tandem below the fuselage, are supplemented by small wing wheels for stability on the ground.



# Winning



THE BARE MIDRIFF



THE TIRED FATIGUES



THE OVERWEIGHT OVERCOAT



# the War on Uniforms

**By Leon Shloss and Irving R. Dickman**

PSM WASHINGTON EDITOR

EX-5/SGT., 26TH INF. DIV., 3RD ARMY

**Sketches by Syd Landi**

EX-SGT., ANTI-AIRCRAFT COMMAND

**T**HE GIs who had to fight bugs, mildew, trench foot and their uniforms, as well as the enemy, will be surprised to learn that, at long last, "something is going to be done about it." Not too quickly, of course; the Army doesn't do things that way. But by mid-1949 the overcoat that doubled its weight in the wet, the raincoat that kept rain out like a sieve, and the overseas cap that kept nothing off a guy's head except a real hat will have their final discharge. Even trench foot and mildew, already staggering, may be licked.

Beginning July 1, 1949, the cotton cap with visor and a combination raincoat-overcoat with detachable wool lining will be part of the standard uniform for officers and enlisted men alike. In addition, War Department Circular #61 calls for general use of many items that began to appear late in World War II.

## *The New Uniform*

From head to toe, the GI stationed in a temperate zone will wear something like this:

The visor cap; wool OD or cotton sun-tan shirt; wool OD trousers; high-neck sweater; Eisenhower jacket; wool socks with cushion sole; combat boots with composition sole; leather gloves with wool inserts; the new field coat.

For field wear, the success of the combat jacket under wartime conditions has led to the designing of a complete uniform, wind-resistant and water-repellent, including hood, jacket and trousers. Designed for wear over the basic clothing, when necessary, the jacket and trousers are to have pockets enough for even the most loaded GI.

These garments, with the summer sun-tans and fatigues, either coverall or shirt-and-trousers, are expected to give the soldier both comfort and protection for all normal conditions. Basis for the changes already

made, and those to follow, is experience in the field during World War II, which opened many a tradition-bound eye. The Office of the Quartermaster General (OQMG) remembers all too painfully how men in every area left behind what was useless or unnecessary.

Eyes were opened, too, by the way GIs voted for their favorite uniforms by the simple method of "liberating," or appropriating, certain items. Few Americans in the ETO, for example, resisted the temptation to get hold of the warm, durable Armored Force jacket and pants when they could.

This display of soldier opinion, more than anything else, led to changes in the GI equipment in the midst of the fighting and is responsible for the continuing research for new and better clothing.

Of course, not all Army traditions have been broken, but the replacement of such items as the wool overcoat, the raincoat, leggings and overseas cap will be welcome to most GIs. And enlisted men will undoubtedly acclaim the elimination of special uniforms for officers.



But to the OQMG experimenters at Philadelphia and Lawrence, Mass., even more important than their work on the regulation uniform is the development of clothing to meet new American responsibilities all over the globe, with special problems of frigid and tropical climates. The





VISOR CAP

WOOL SHIRT

EISENHOWER JACKET

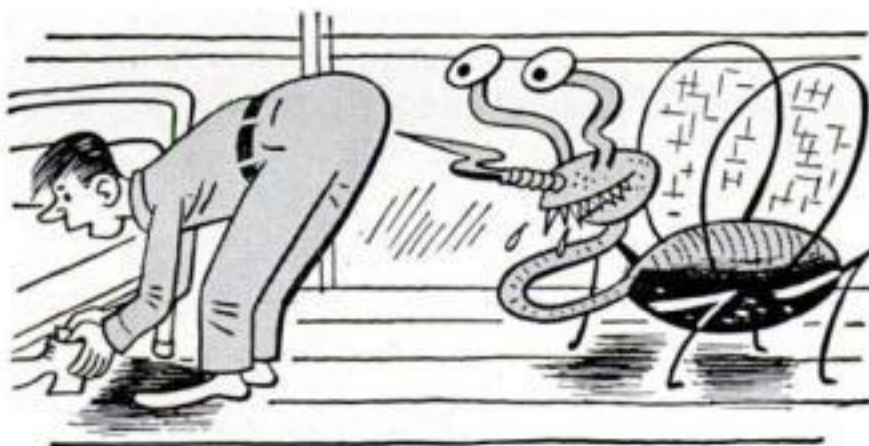
WOOL TROUSERS

HIGH-CUT SHOES

One major change in the basic uniform will be the Eisenhower jacket, cut long enough to eliminate the break at the waist. Pocket space remains scanty, and low-cut shoes for dress wear won't be "issue."

OQMG remembers the Bulge, where trench foot put even more men out of action than enemy fire, and the Pacific campaigns where men had to fight mildew, mold and insects.

Of the special problems, most difficult to solve is that of keeping the body warm and capable of movement in the subzero temperatures of the Arctic and Antarctic. For each degree of temperature below zero, a man must use two percent of his energy just to keep warm. At  $-50^{\circ}$ , all a man's time and energy would be occupied in staying alive. In last winter's Operation Frigid, however, it was discovered that cold of  $-60^{\circ}$  is the rule, rather than the exception.



To meet these conditions, experiments are now testing the "layer principle" developed by Paul Siple, of Army QM, who has spent more time in the Antarctic than any other American. Siple accompanied all the Byrd expeditions, and on the first one he got on the track of the layer principle.

Instead of loading the body down with furs to keep it warm, Siple reasoned, why not take a lesson from the men who had to stay outdoors all day long—from hunters and woodsmen and farmers? Why not wear several garments of cotton, known for its absorbent qualities, and take off or put on as many as necessary?

Based on this idea, clothing has already been developed that will keep an immobile soldier warm indefinitely at  $-14^{\circ}$  in a four-mile-an-hour wind. At  $-60^{\circ}$ , an active soldier wearing the new clothing can last two hours. To do even this, over the regulation shirt and trousers, high-neck sweater and field jacket, he must wear the following: a fur liner, pile inside; a second fur liner, pile outside; a fur-lined parka; a fur-lined cap with visor, covered by the fur-lined hood of the parka; woolen gloves, covered by woolen mittens, covered in turn by leather-and-fur shells; field over-trousers.

A choice of footgear is available: combat boot, shoepac or mukluk. The mukluk is good down to  $-60^{\circ}$ , but its soft sole wears



badly on rocks, and its lack of arch support prevents its wearer from carrying heavy loads any great distance. The warmth of the mukluk is increased even further by wearing inside it two pairs of ski socks, two pairs of cushion-sole wool socks and two pairs of felt inner soles.

Thus attired, the polar soldier has reached the point of diminishing returns. His weight has been increased by 30 pounds, and his body area has been increased to the point where heat loss almost exceeds heat retention. Tests show that the next step must be protection either by electricity, like flight uniforms, or by such insulating compositions as fiberglas.

The problem of footgear is a puzzler all its own. The combat boot, possibly the most publicized clothing item of World War II, never was truly loved by its wearers. If the boot was completely watertight, the foot, unable to "breathe," perspired. Trench foot resulted. If the boot was porous enough to permit air circulation, water got in, too. Again trench foot was the result.

Best all-around boot to date is the leather-topped, rubber-footed shoepac, some models of which reached combat units in the winter of 1944-'45. The doughfoot, who took the shoepac gladly in his foxhole because it cut trench foot by 85 percent, had to toss it



away on the road when his arches broke down after a couple of miles of marching. He may be interested to know that this was only another case of Army snafu. Col. M. E. Barker, in the April 1947 *Infantry Journal* points out that the Army failed at any time during the war to provide the inner sole with arch supporter for the shoepac, which would have made a tremendous difference.

Chief drawback, even in the latest model shoepac, is leakage where the rubber and leather are stitched together. The solution may come through one of the various cements or treated threads now being tested.

One of the cold-climate problems already well on its way to being licked is that of



DETACHABLE LINER



LEG PROTECTORS

**Field coat** with sateen shell and a detachable wool liner, both water-repellent, will replace the old overcoat and raincoat. The trouser hoods button around shoe tops for protection from heavy rains.

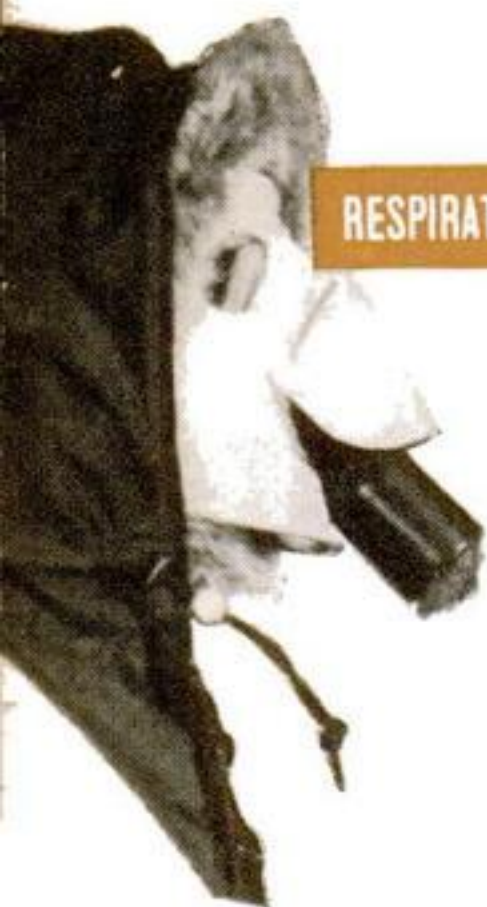




**BASIC "LAYERS"**



**FUR-LINED PARKA**



**RESPIRATOR MASK**



**SNOW CAMOUFLAGE**

The colder it grows, the more layers you put on, starting with the basic field dress and ending up with snow camouflage suit when necessary. The respirator mask protects lungs from extreme cold.

giving the soldier a chance to get plenty of air into his lungs. Offhand, that might seem to be no problem at all, but at temperatures of 40 to 50 below zero, the amount of heat lost by merely breathing is of serious concern.

The solution was the invention of the heat-regenerating respirator, a device that retains the warmth of an exhaled breath and uses it to warm up the next lungful on its way in. This saves the soldier from breathing painfully cold air and helps conserve the warmth of his body.

In the hot Pacific and other tropical areas, you undress instead of dressing. Comfort lies in taking as many clothes off as possible. While the Army has not yet taken the seemingly logical step of adopting the British and Aussie uniform of sport-shirt-cum-shorts, which many GIs adopted for themselves, a great deal has been done to give the soldier greater protection from the chief natural hardships of jungle warfare—sun, mildew, undergrowth and insects.



Chief development in this field is a new light fabric impervious to these annoyances, including the sting of insects, which had a field day on wet sun-tans.

One of the most important single steps in the campaign to increase military health and comfort was accomplished recently in the Biological Laboratories of the Philadelphia QM Depot. A team of biologists and chemists, headed by Dr. Ralph G. H. Siu, gained what appears to be final victory over mildew damage.

Not only did mildew, common term for about 400,000 destructive fungi, cause incalculable monetary damage; its cost in discomfort and illness among American troops was far more important. In an effort to lick this pest 30-year-old Dr. Siu, a native of Honolulu, sent scientific missions all over the world. Using their reports, he reduced the number of fungus and bacteria malefactors to about 10,000. Two hundred of these were marked as chief offenders, of



which a score were finally identified as the most destructive.

Dr. Siu found that when fungi attack a cotton fiber they use an enzyme, an organic substance serving as an agent for breaking down the main component of the fiber, cellulose. The enzyme first attacks the molecule of the cellulose and converts it into sugar, after which the fungus is able to absorb the sugar through its cell walls. Most important of the discoveries was that for the enzyme to convert the cellulose molecule into sugar, it first had to match, at least roughly, the shape of the molecule. It seemed, therefore, that the most hopeful course lay in changing the shape of the cotton fiber molecule, thereby making it impossible for the enzyme to attach itself.

Further studies showed that several treatments already administered to fabric for fire resistance, water repellency and other purposes *actually changed the shape of the cellulose molecule*. Fire resistance and mildew resistance in a single treatment are therefore possible.

OQMG believes that soon it can develop a "one-shot" treatment that will make fabrics resist fire, water, mildew, sunlight, shrinkage and possibly even abrasion.

#### Testing Clothes and Men

Behind most of the uniform changes, and the conquest of such pests as mildew and trench foot, lies the constant research program of the OQMG. At Lawrence, rain rooms, cold rooms and hot rooms have been set up in which both clothing and men are subjected to the severest climatic tests.

In dealing with the comparatively new field of dressing and equipping armies scientifically, the researchers first did not have even a standard of measurement. The standard finally evolved was the CLO. One CLO was said to be equal to the amount of clothing needed to keep an inactive man comfortable in a windless room at 70°.

With this new yardstick, research parties set out to map weather conditions in every accessible region of the earth, month by month. Weather charts were then drawn in CLO units. The "clothing almanac" made up of these CLO unit charts has now become the basic QM guidebook.

Whatever uniform changes are evolved, whatever the new equipment designed, the basic purpose of the QM researchers remains unchanged: to make the GI's life, whatever the conditions may be, an easier one. END



RAIN TEST

Rain court at OQMG laboratory tests clothing in fogs, drizzles or downpours.



GLOVE TEST

Testing dexterity while wearing gloves; polar troops can't work without them.



SHOE TEST

Soaking shoes for hours at a time is one step in the battle against trench foot.



# Typewriter Catches Mistakes

**S**TENOGRAPHERS can throw away their erasers when they get one of the new "errorless" typewriters. It gives typists a chance to catch mistakes by showing them what a complete line looks like before it is printed. Not until errors have been corrected does any type strike the paper.

The letter keys act only as selectors, closing electrical relay circuits that determine which characters will later be printed. They also position indicators in a window above the keyboard, the way some adding machines do.

After an entire line has been set up in this manner, the typist can read it over and make changes if necessary. Then the print key is pressed, printing the whole line shown, one letter after another.

Lines can also be justified—expanded or contracted to make the right as well as the left margin exactly even. Another feature is a signal to tell the typist how much space remains at the bottom of the page. In addition, the machine can be equipped with different sizes and styles of type.

Striking the keys permits a series of movable bars, one for each space in the type line, to slide forward until stopped by pins representing the various letters to be used. The letter keys are simply switches controlling solenoids that drop the proper pins into the stopping positions.

When the print key is struck, a sensing carriage moves across the bars and connects each one, one at a time, to the letter its position represents. Completion of this electric contact makes the letter strike the paper. The paper, unlike that in other machines, remains stationary while the type assembly moves with the carriage from left to right. Line spacing is automatic.

Invented by Robert S. Wallach, president of the Associated Development and Research Corp., the machine is still in the experimental stage, and production is not expected for at least another year.

Cost? The first ones will probably sell for a little less than \$1,000. Later, mass production models—minus a few of the de luxe features—may be made for about \$250.

## Skystreak

### *This Month's Pin-up*

**S**LEEK, sturdy and stub-winged, the jet-propelled D-558 Skystreak may be the first piloted plane to attain the speed of sound (PSM, Mar. '47, p. 93).

Built by Douglas for the Navy, the craft's TG-180 turbo-jet engine develops a force equal to that of four B-29 engines wide

open. Its unbraced, tubelike magnesium fuselage is 35 feet long, while its thin wings have a span of only 25 feet.

Designed to withstand loads greater than 18 times the force of gravity, it features a jettisonable cockpit for pilot safety and hydraulically operated air brakes.



Split-nose scoop channels air past pilot to engine.



Tiny tires are eight-ply nylon inflated to 230 lb.









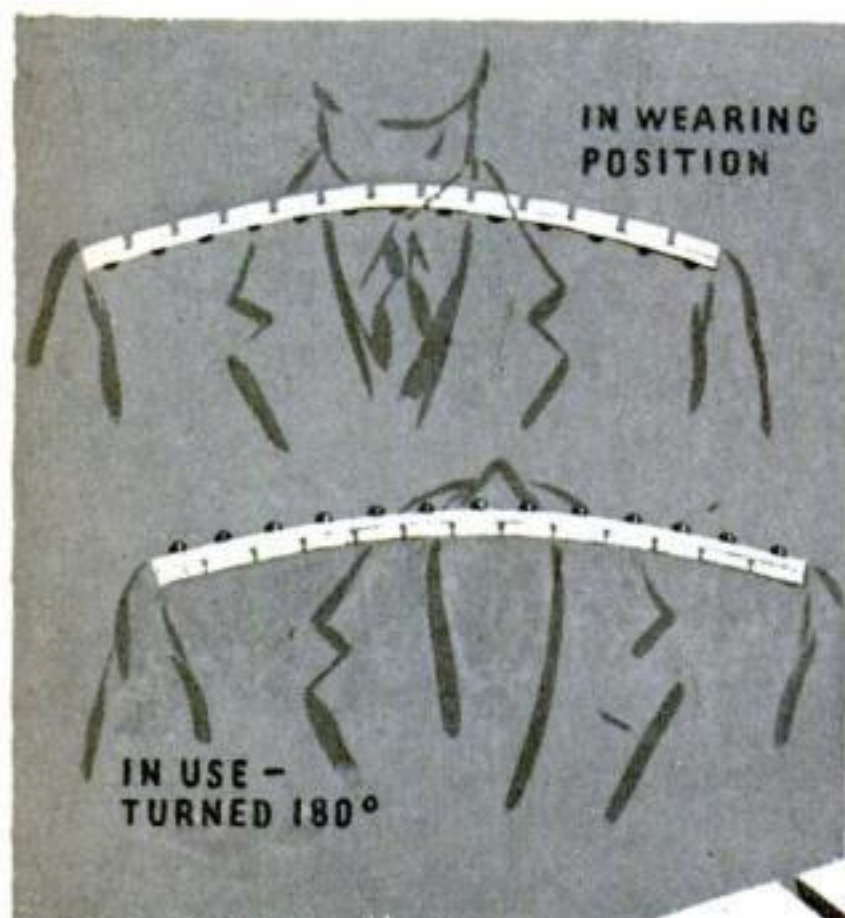
# NEW IDEAS from the INVENTORS



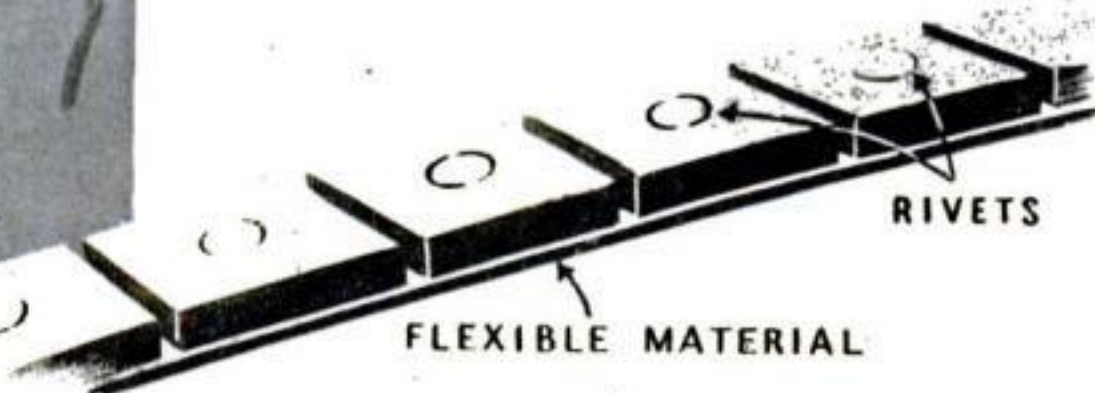
**Helium-supported Hangar.** To simplify the housing of large planes, Emil R. Capita, of North Bergen, N. J., has designed a tentlike fabric hangar. Its top contains hollow cells that, filled with helium, hold up the roof and help support the walls, which are guyed to tent pegs.

## "Windmill" for Landing Gear.

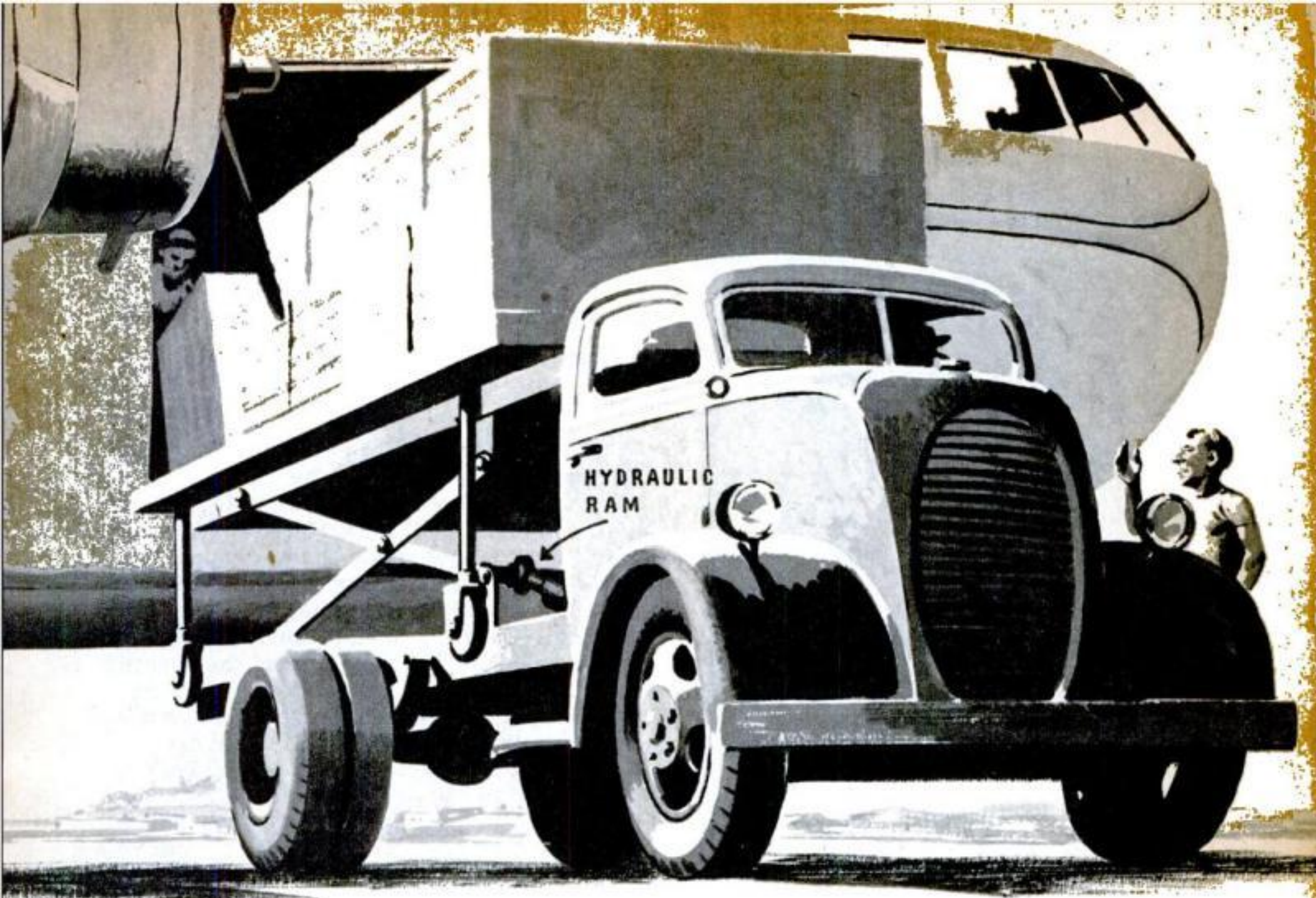
Pre-rotation of airplane wheels to lessen landing friction is achieved by cupped vanes in an invention by Bernard D. Branner, of Waterford, Conn. The vanes, which can be separate units or a single circular casting, can be attached directly to the wheel rims.



**Built-in Coat Hanger.** A man could hang his coat on any hook and not worry about wrinkles with a coat hanger invented by Rudolf Senn, of Basle, Switzerland. It is a strip of flexible material with a series of closely spaced blocks on one side. Fitted loosely into a sleevelike covering, stitched in the shoulder lining, the strip bends freely when the blocks are uppermost. Turned over so that the blocks jam together and restrict bending, it forms a rod that holds the coat in shape.

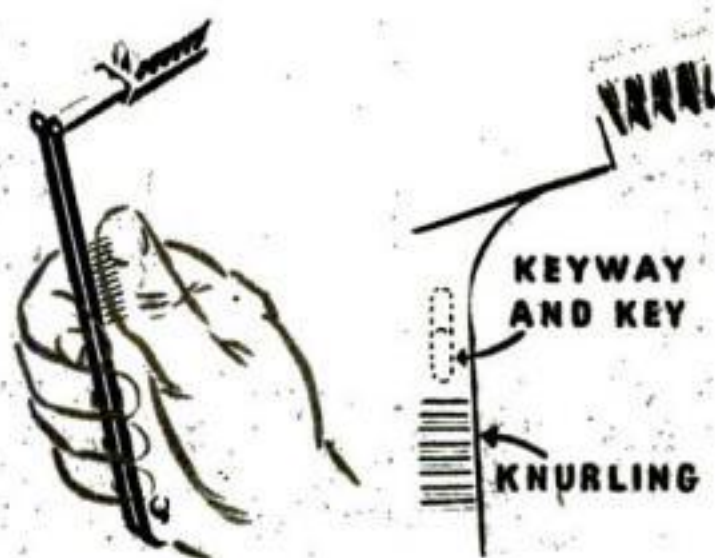






**Air-cargo Elevator Truck.** For speedier loading of cargo planes with fewer trucks than are ordinarily required, Norman Kuehlman and Henry French, of Wisconsin, have designed a truck with a hydraulic lift and a separate freight body. The freight section has movable legs and

wheels, operated by an electric motor independent of the truck itself. When the legs are raised, the body automatically locks itself to the truck; when they are lowered, the body is released. The design permits one truck to handle several freight bodies, hauling one while others are loaded.



**Mechanized Toothbrush.** The handle of a toothbrush invented by Emanuel Aaron, of New York, is divided into two sliding parts. Moving them up and down in relation to each other (which can be done with one hand) causes the brush head to turn back and forth against the teeth.

**Vertical Clock Face.** A drum with a dark pattern of 12 steps on it, visible through a vertical slot marked in hours, is the face of a clock devised by Joseph L. Smith, of Chicago. The highest portion of the dark pattern shows the hour; its horizontal width indicates minutes.





# From Egg

**It takes eight weeks and a rock to become a land dweller**

**T**O MAKE this pictorial life history of the lowly toad required the talents of a hunter, aquarium keeper and photographer—all combined in Hal H. Harrison. Having a wife with a photogenic thumb helped, too.

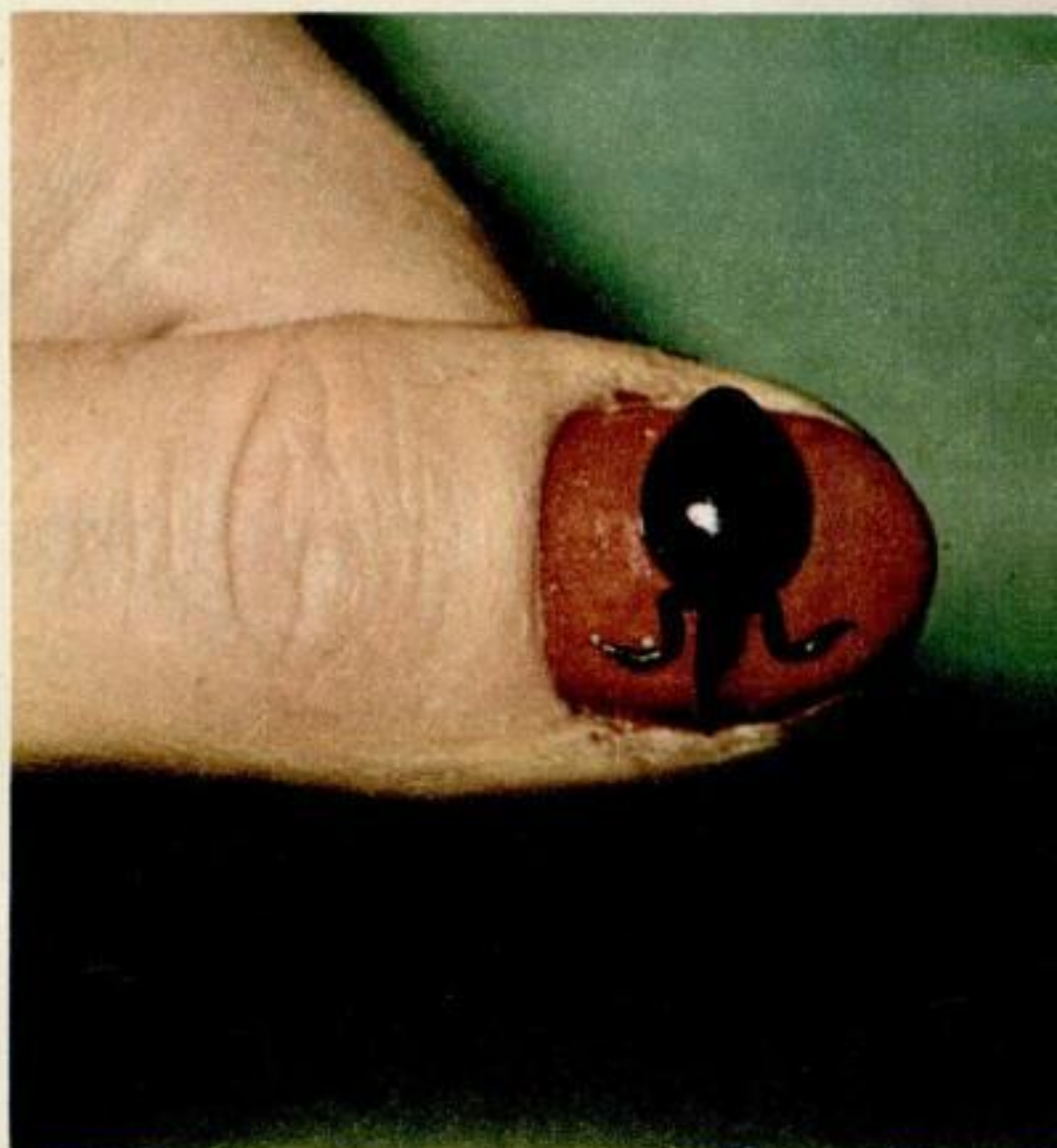
The first task was capture of a pair of toads, male and female. They were kept in the small aquarium in Harrison's home until the female laid her eggs; then they were turned loose. It was at this point that picture-making began. The eggs were photographed when only about an hour old.

The tadpoles, which hatched in about a week, lived in the aquarium, feeding on the minute plants it contained. Whenever a casual inspection revealed a distinct change in

The eggs of the American toad resemble strings of beads covered with a gelatinlike material. The toad starts his life in the water, but leaves after a few weeks and returns only for breeding.



After about a week, the egg hatches into a tiny tadpole. With the help of the long tail, it can wriggle around in the water. It cannot live in air.



Appearance of the hind legs signals the beginning of the change into a land animal. At this stage the tadpole will crawl out of the water for brief periods.

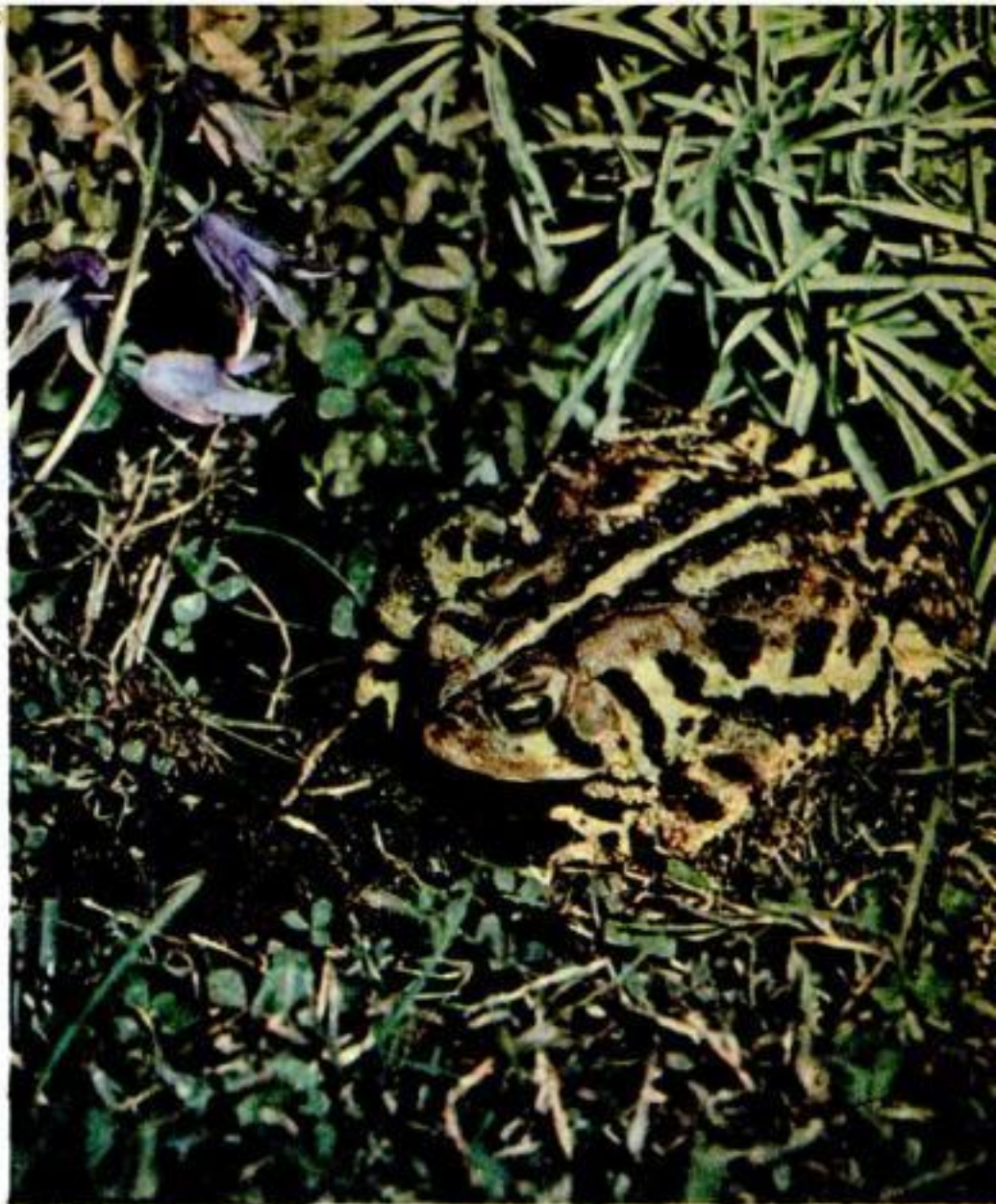


# ...to Toad

the tadpoles' appearance, one was picked out of the water and posed on Mrs. Harrison's thumbnail to indicate size.

Pictures were taken regularly during the eight weeks a toad needs to change from a squirming water animal to a four-legged land dweller. At one point in their growth, Harrison was puzzled when the tadpoles' legs failed to appear on schedule. A naturalist friend suggested partly submerging a rock in the aquarium. That did the trick. As soon as the tiny animals had a way to crawl out of the water, they began to grow legs.

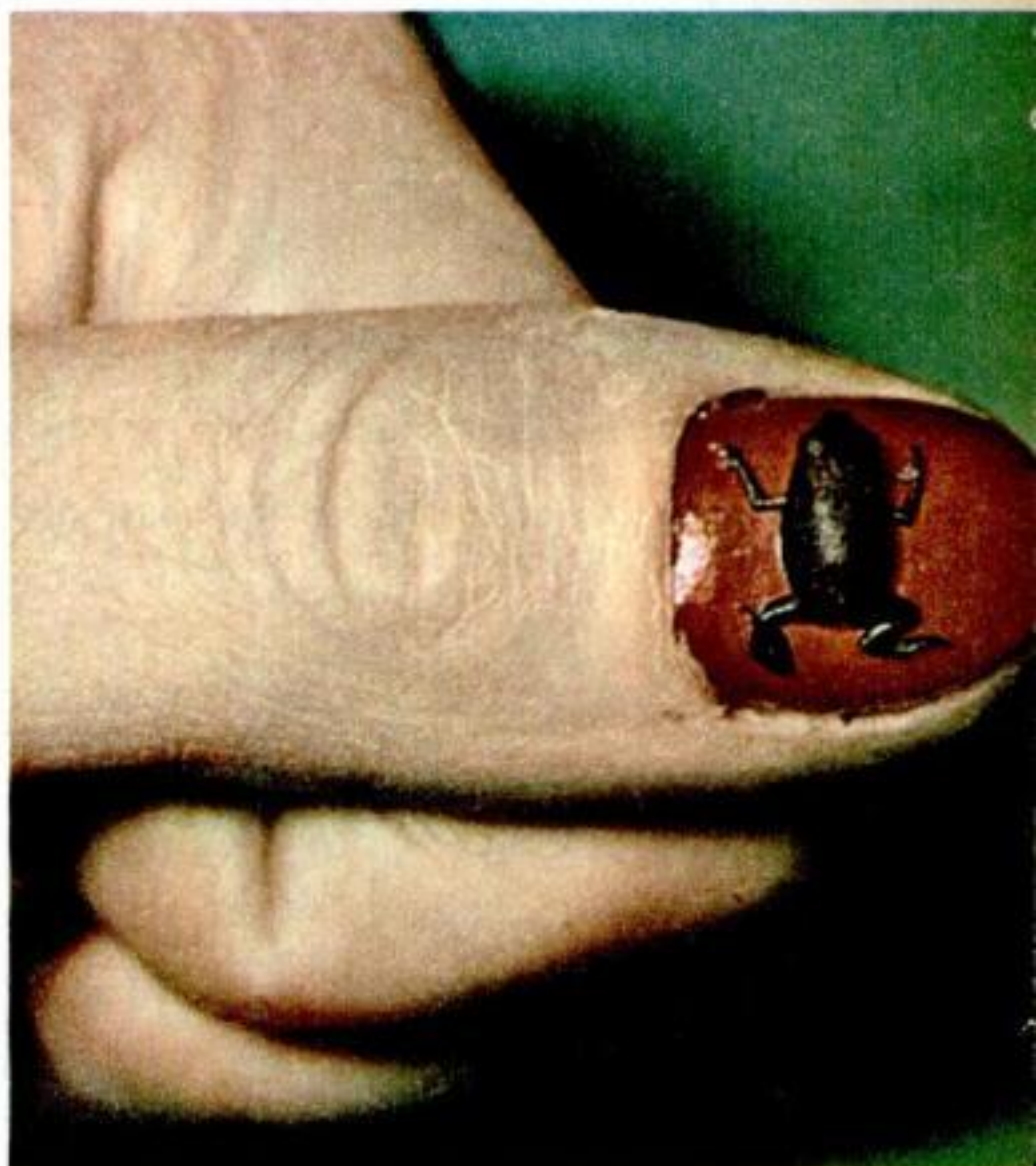
The transparencies were made with a  $3\frac{1}{4}$  x  $4\frac{1}{4}$  Zeiss Maximar, using a single flash bulb held near the camera. A piece of green blotting paper furnished a simple background with pleasing color contrast. "I was lucky during those eight weeks," reports Harrison. "My wife didn't change the color of her nail polish."



When full grown, the toad is about two to three inches long; thanks to its camouflage coloration, it is almost impossible to see. The toad is highly prized by gardeners, for it eats harmful insects.



Next come the front legs. The tail remains, although now it is not so large compared to the rest of the body. Soon it disappears completely.



About eight weeks after the eggs were laid, the tadpole has become a toad. No longer able to breathe under water, it must now live on land.



# I'd like to see them make

Cartoons by SYD LANDI

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science Monthly* will pay five dollars for every such suggestion that its editors decide to publish. Suggestions cannot be acknowledged or returned.



**Two-in-one Hair Aid.** To save time and insure good grooming, Ernest Narias, of Tampa, Fla., suggests a comb that would dispense hair tonic through its teeth.



**Portable Traffic Lights.** Where permanent ones are not needed, they would save taxpayers money and the police time, says L. E. Cottingham, of Rowland, N. C.



**Splashless Bathtub.** One with a watertight top would let Junior splash to his heart's content and keep the house dry, thinks Bob Binks, of New Orleans, La.



**Hot-water Warning.** To safeguard the dishwasher from scalding water, L. F. Chambering, of Longmeadow, Mass., would equip the faucet with a thermometer.



**Sure-find Seat Lights.** Small lights on vacant theater seats would take the guesswork out of hunting for one, declares L. J. Herbert, of Lexington, Mass.



**Rain Guards for Mailboxes.** Anyone who has tried to mail a letter in the rain would welcome protection, believes Dorothy Tooker, of Larchmont, N. Y.





With television, the make-up artist has crashed the broadcasting studio—and uses the latest scientific methods. Here moulage (casting material) is applied to the face of actor Stephen Courtleigh, being made up as Abraham Lincoln.



The complete moulage mold is removed from Courtleigh's face—and it doesn't even stick to his hair. A positive cast of the actor's face will now be made from the negative moulage. The make-up is for a broadcast over station WNBT, New York.

## ***Sculping a Television Lincoln***

The make-up artist, Richard Smith, compares the cast of Courtleigh's face with one of Lincoln's. To make them look alike, he applies latex rubber to the actor's cast for higher cheekbones, ridges over the eyebrows, prominent nose and bigger chin.



The rubber pieces modeled on the plaster cast are applied to the actor's face to give it Lincoln-esque contours, including the famous wart. Make-up and grease paint will now be applied over the new features for the final illusion of reality.



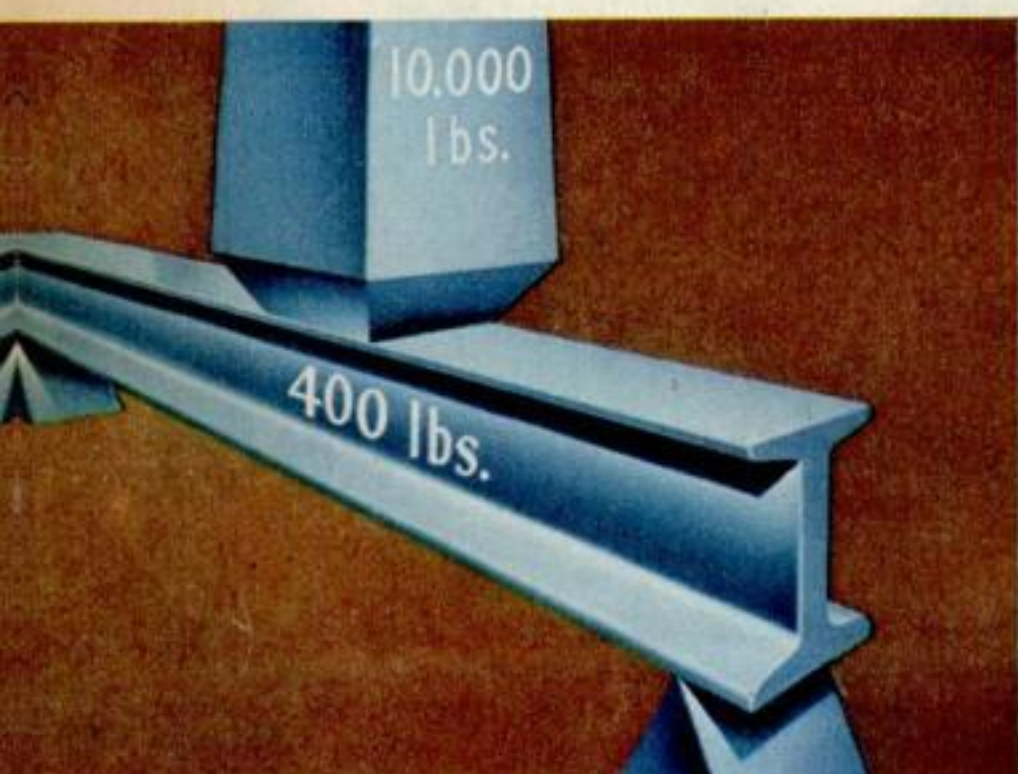


# Movie Cartoon Shows Welding Benefits

**M**AN is always seeking better ways to join things together. First he tied them together with rawhide; later he used wooden pegs, iron spikes and nails, bolts and nuts, and then rivets. Finally, as shown by these pictures from the film *Design for Arc-welded Structures*, made by Herb Lamb Productions for the Lincoln Electric Company, arc welding has gone a step further in removing limiting factors. Electrical welding allows more freedom of design. It permits structural members to be joined

directly, retaining the full strength of the material in any combination of shapes.

Modern design is arc welding's partner in making cheaper and better girders. Two channel sections can be welded to form a box section, impossible with riveting. Special shapes of I-beams may be welded from plates of different thicknesses. Tension and compression members, and beams can be welded without adding weight or losing strength. This sequence from the film tells the story of a welded plate girder.



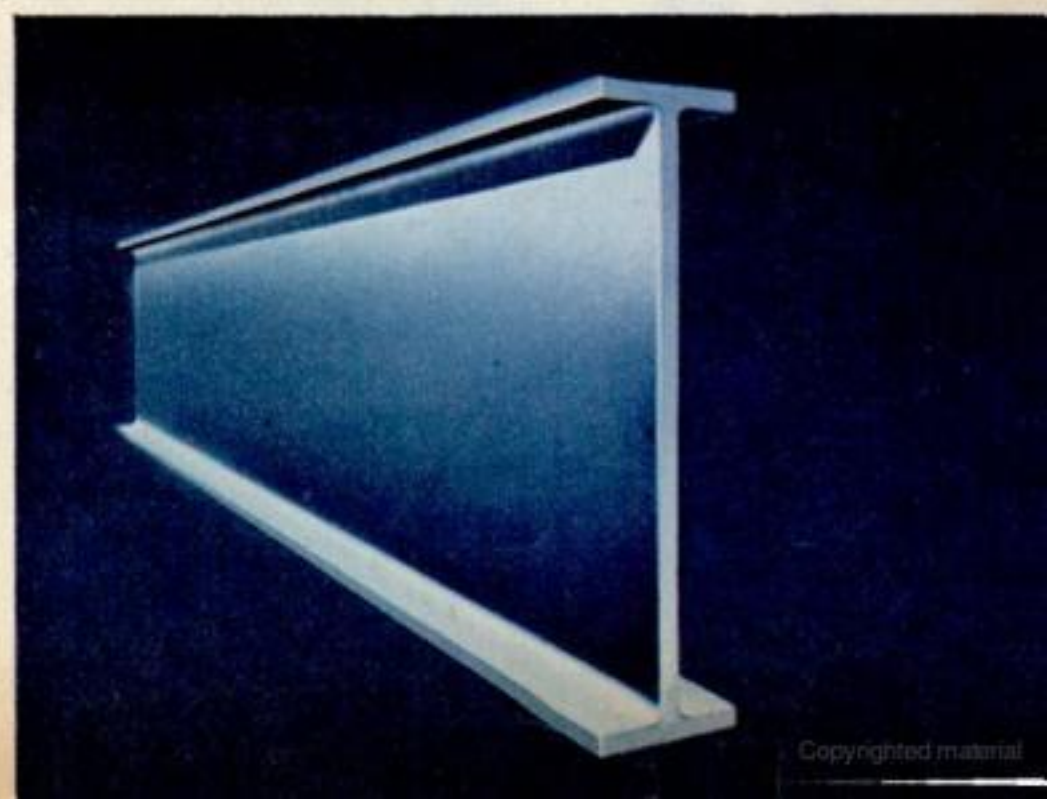
3. Twelve hundred pounds of useless material have been removed and the I-beam now weighs only 400 lb. Yet it will still carry 10,000 lb.—in fact, it will bend less than the solid beam four times its weight.



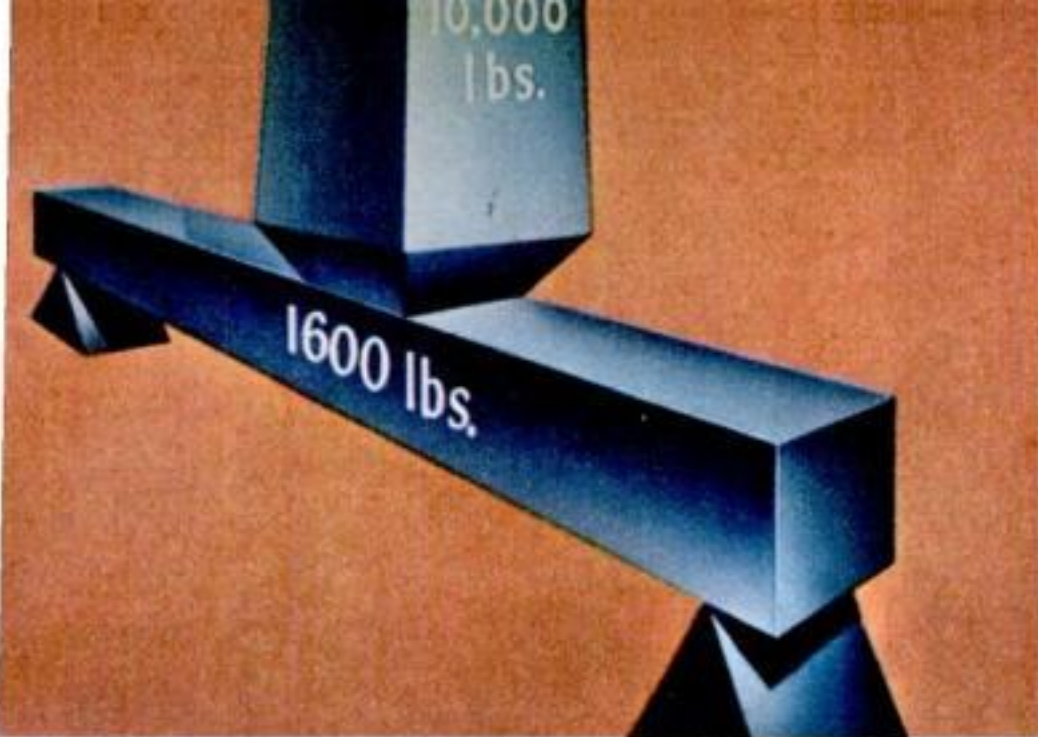
4. This riveted plate girder, used for bridgebuilding, offers a typical example of how a combination of good design and the latest fabricating methods can cut weight and costs.

7. The answer, says Lincoln, is arc welding. No rivets are used, the flange angles are not needed and no weakening holes are made. The designer needs only the web plate and a pair of 1½-inch plates. The result is a streamlined girder.

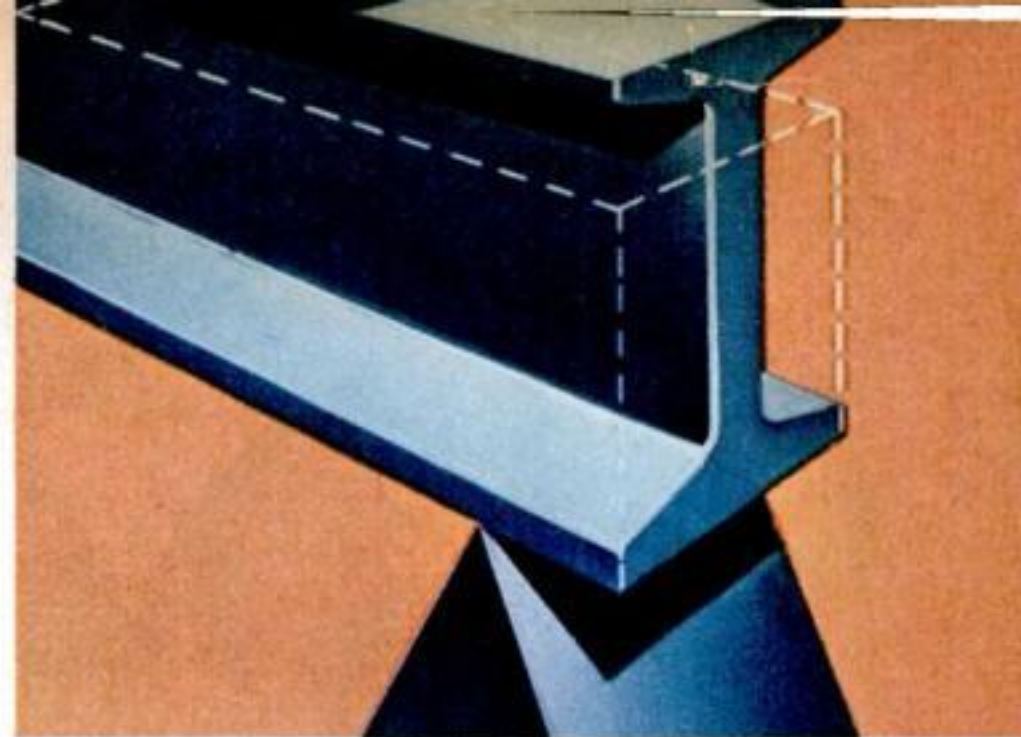
8. There are no overlapping flat surfaces, no holes, no excess bulk and weight. The structural members are joined directly, retaining the full strength of the material. Of course, any combination of shapes is possible with arc welding.



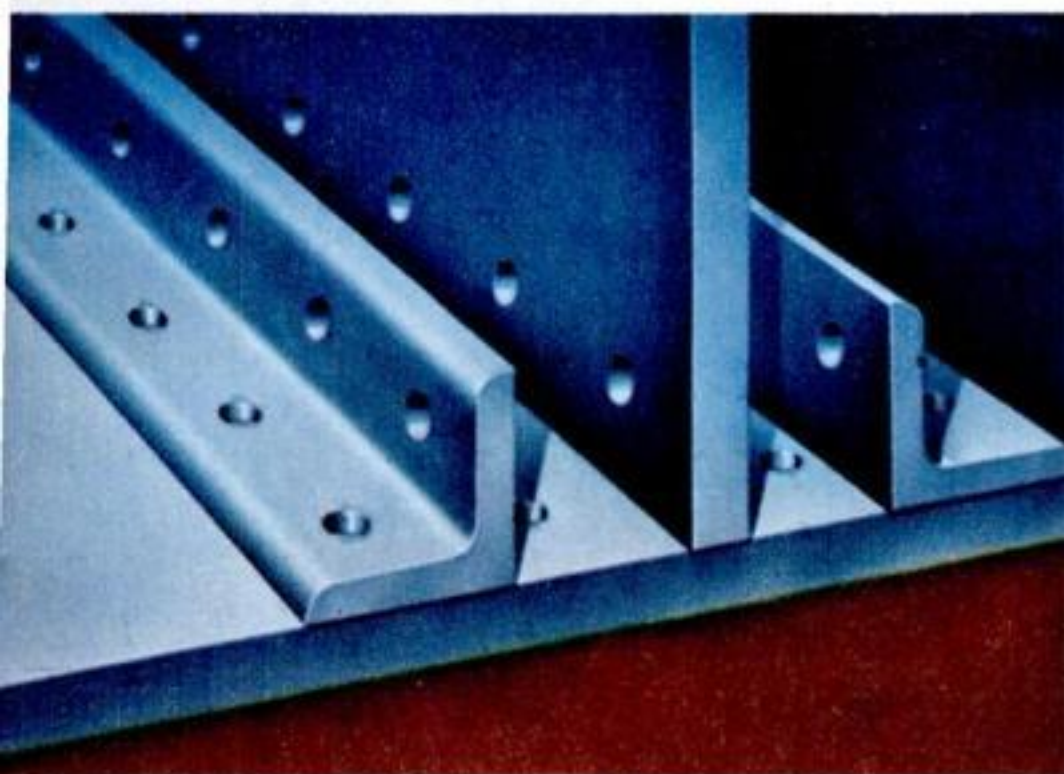




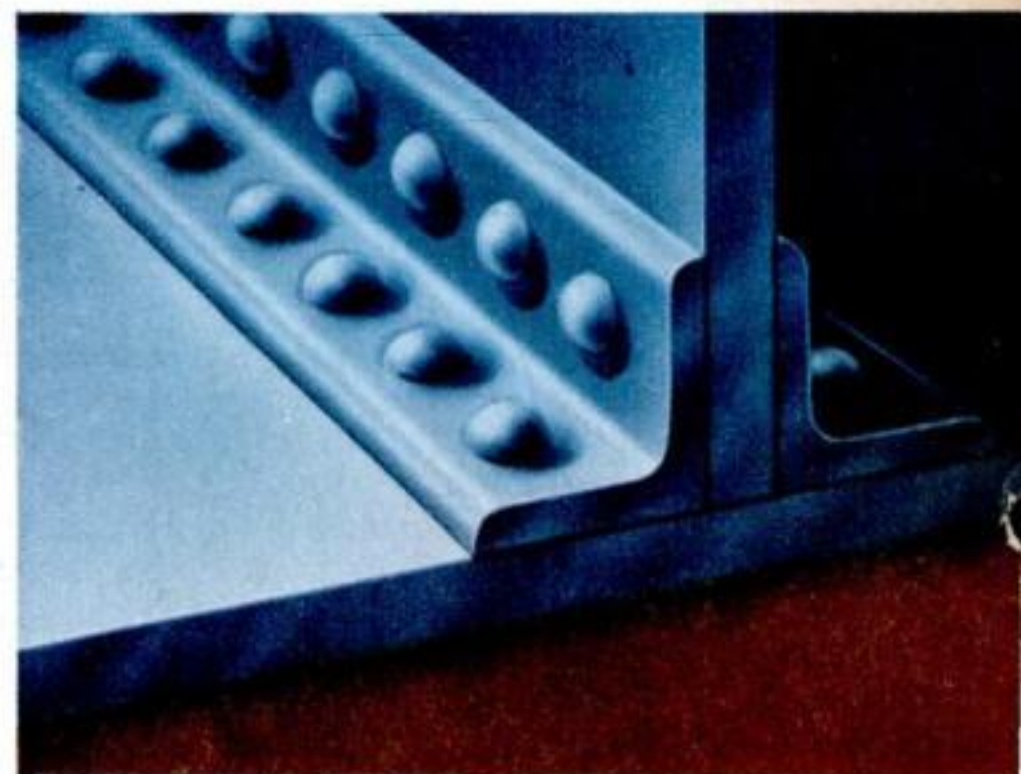
1. The load capacity of a beam depends primarily on its shape. When it is a solid bar, as above, about 1,600 lb. of material is required to support a 10,000-lb. load; much material is wasted.



2. Modern design methods remove the idle material from the solid bar. This results in the I-beam shown above. Useless material has been cut away, trimming the weight while maintaining the strength.



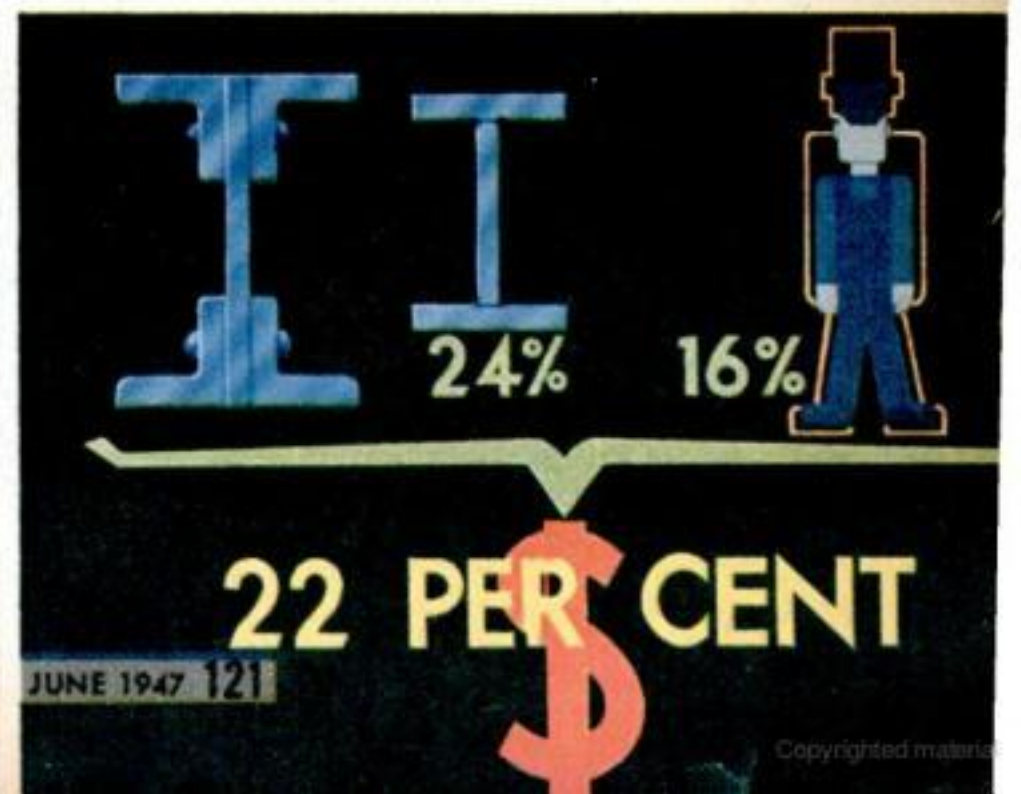
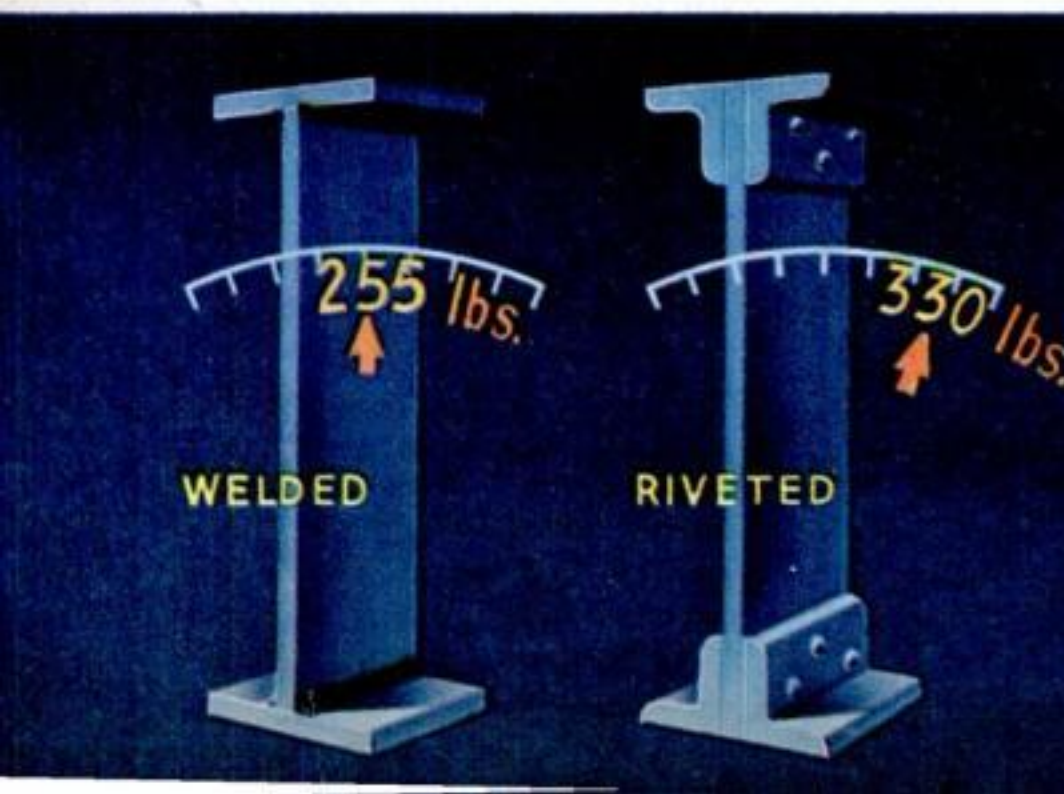
5. Riveting this simple girder requires a heavy web plate and flange angles. Punching rivet holes removes metal and weakens all parts; to offset this the section must be larger—and heavier.



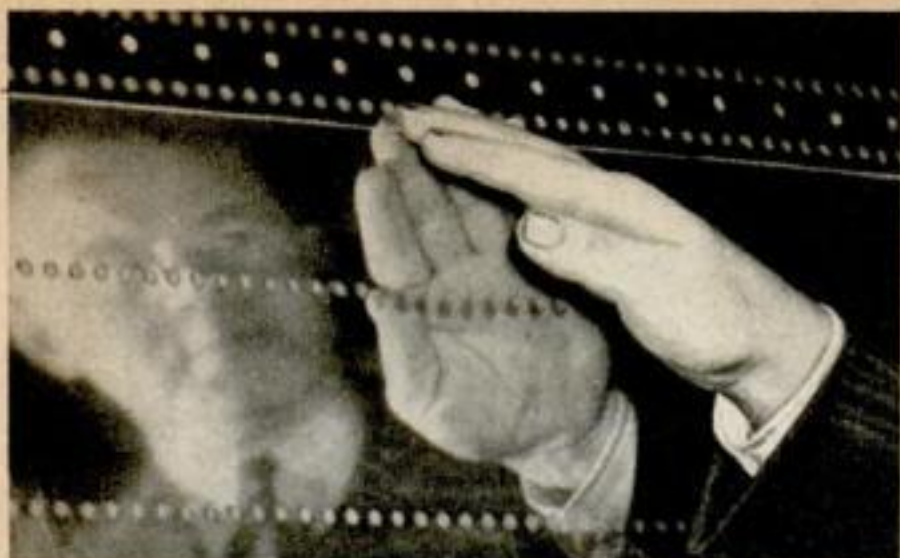
6. Joined and riveted together, the parts form a bulky, heavy union. By using some method that eliminates the riveting, the added weight can be avoided without decreasing the girder's efficiency.

9. How do riveting and welding stack up for weight and material used? When stiffeners are added, each lineal foot of the riveted girder weighs 330 lb., against 255 lb. for each foot of arc-welded girder. One-quarter of the weight is saved.

10. Including lower labor costs, the saving in dollars adds up to 22 percent. Similar weight and cost savings can be achieved by arc welding tension and compression members, either in standard structural shapes or in tubular sections.

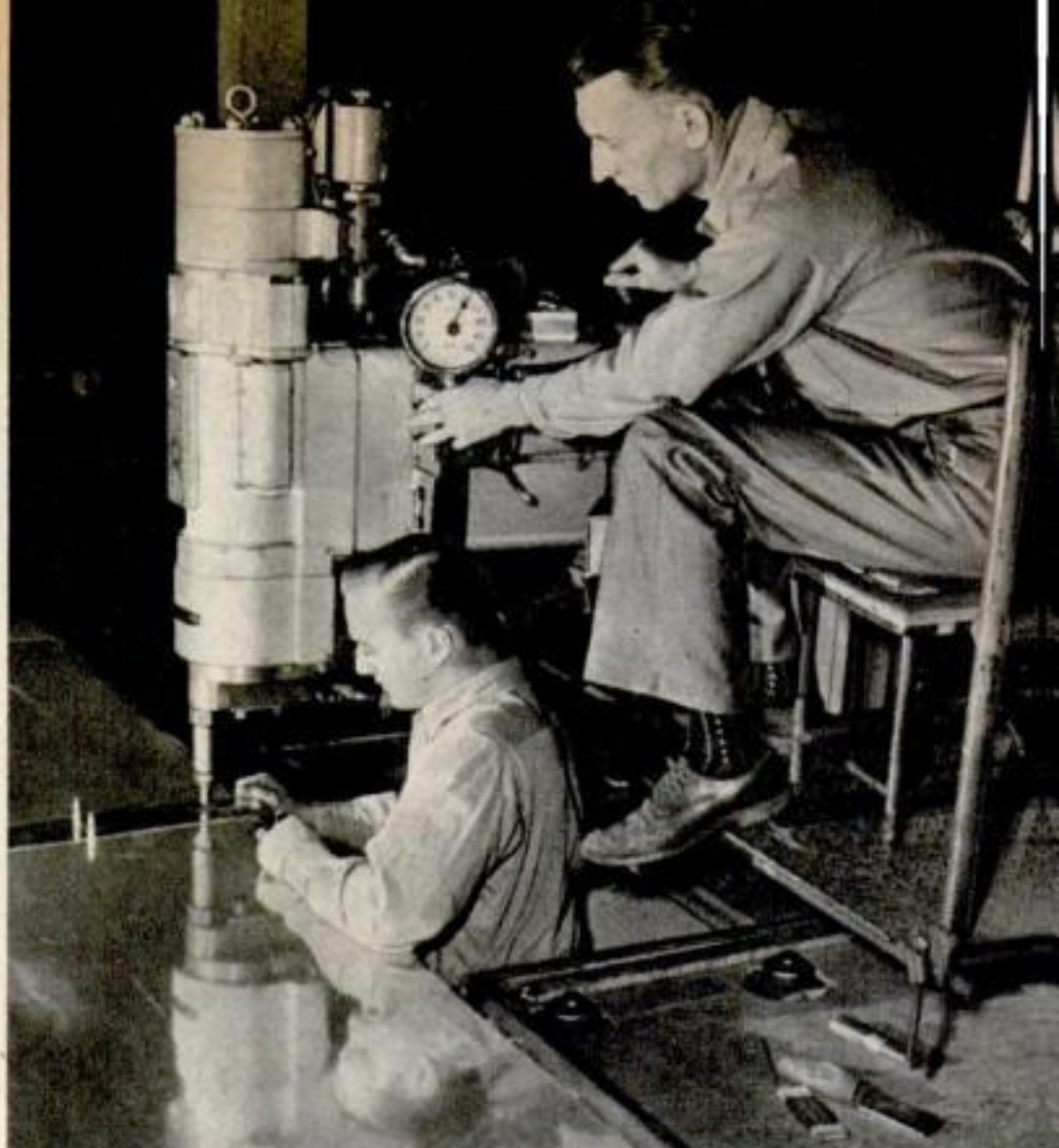






## Air Liners Shed Rivets

SPOT welding, in which two rows of welds equal the strength of three rows of rivets, makes Boeing's Stratocruisers smoother, faster and less costly to produce. At right is an automatic welding machine, electrically stitching carefully aligned sections of body paneling. Above, a finished section of the aircraft skin shows off its smooth surface in a "touch" test.

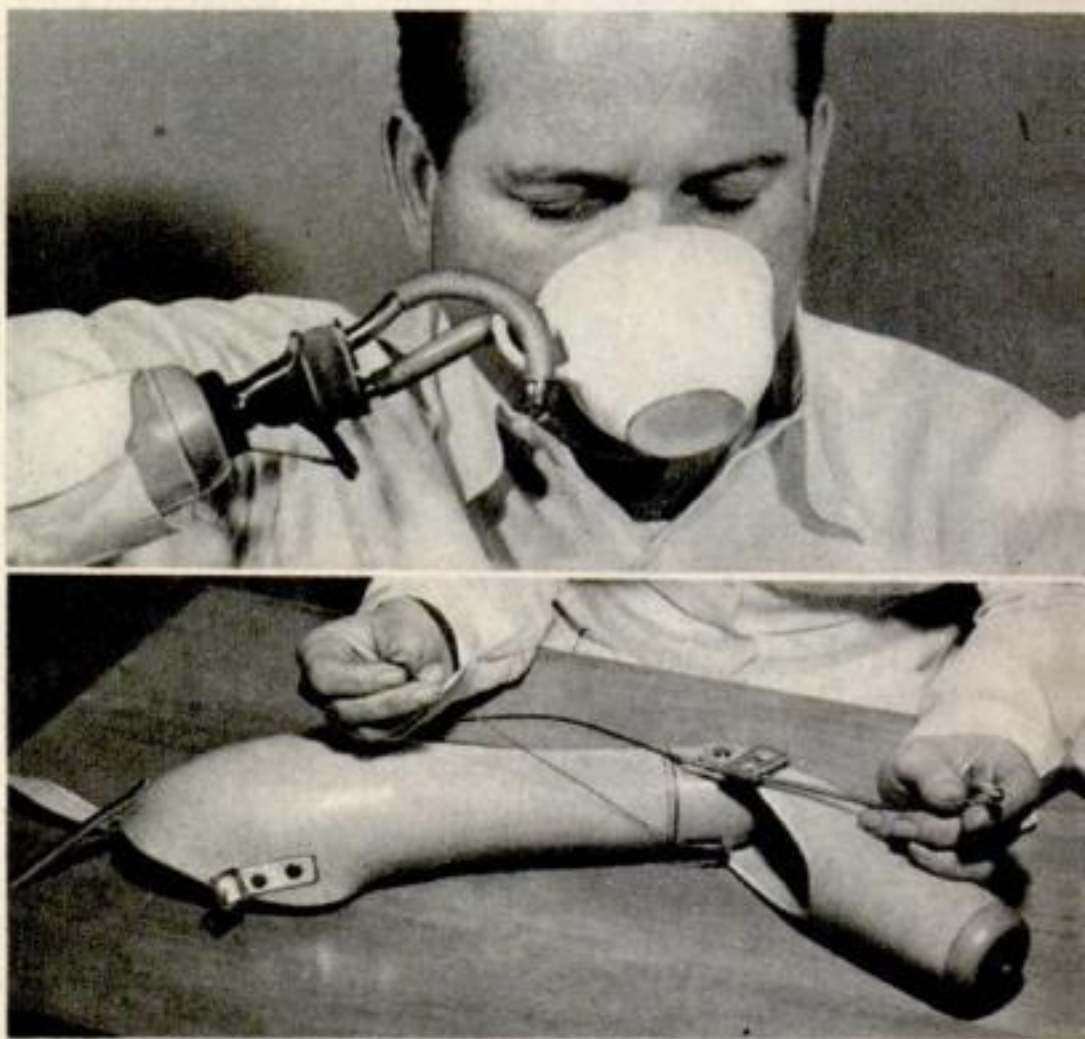


## Lightweight Plastic Arm

AMONG the new prosthetic devices being developed to aid amputees is one engineered by Northrop Aircraft: an artificial arm that weighs less than two pounds.

Formed over a plaster cast as a light but rigidly strong plastic shell, the arm has wire controls similar to aircraft control cables, instead of the leather thongs formerly used to guide the metal hooks that serve as a hand. The photos at right show the arm partly assembled (bottom) and in use (top). For amputations below the elbow, the Northrop arm has a "rotating" wrist, operated by movements of the forearm, that contains a set of gears to increase the wearer's dexterity. The wrist can be locked in any position to lift heavy objects without danger of slipping.

The new arm is being distributed by the Rexall Prosthetics Service Center in Los Angeles, established as a model for other such centers throughout the country.



## Photo Tube Is a Midget

DESCRIBED as the smallest photoelectric cell ever produced commercially, the tube shown at right is only one-quarter inch in diameter and little more than an inch long. Developed by RCA, it works just as bigger tubes do—reacting to light entering a window at its larger end—and is expected to find many industrial applications where space presents a problem.





# ***Safety Rides a Scaffold***

JACK FRANKEL, a painter with a personal knowledge of the hazards of scaffolds (he was injured and his partner died when one gave way) has invented a device to eliminate those hazards. It is a viselike steel hand that clamps on a rope or cable. Fastened to a leather harness, it supports a workman if his scaffold breaks or slips. Pressing a release lowers the wearer to the ground, three feet at a time.



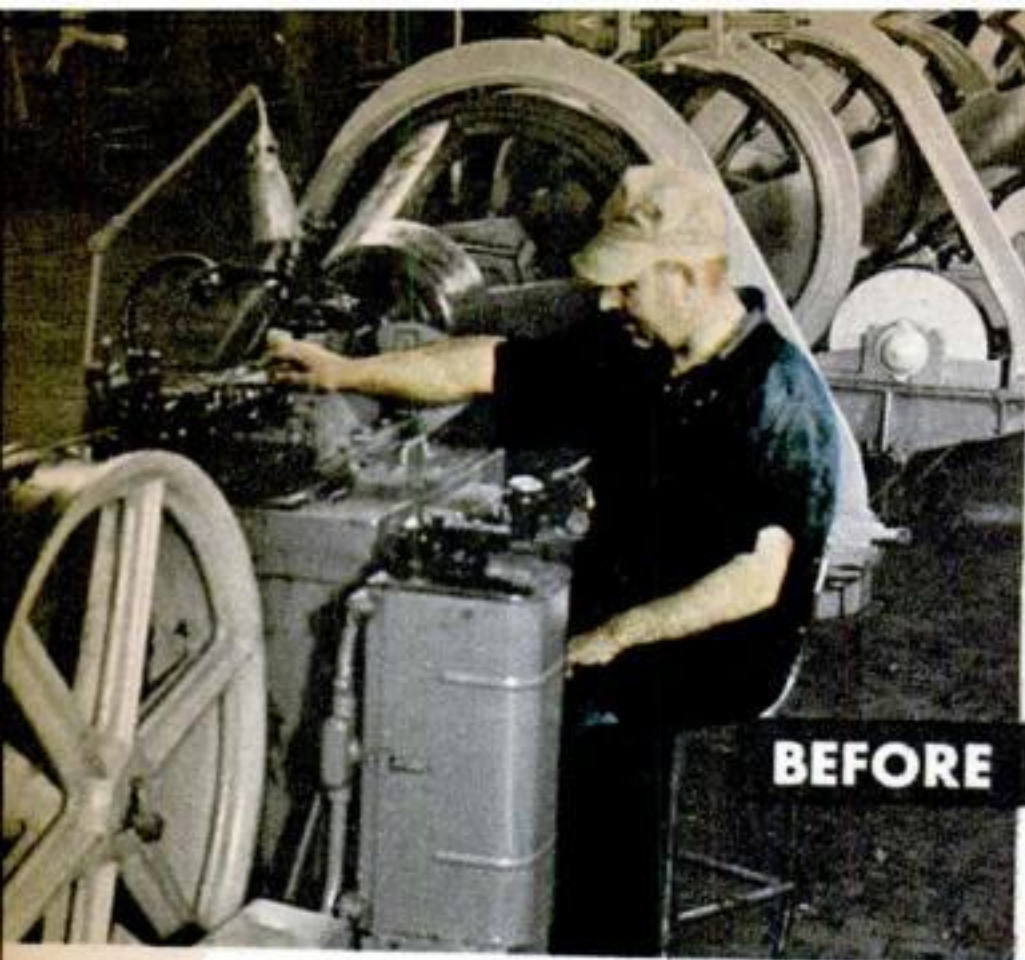
Turning the knob clamps a rope firmly in the grip, which is fastened by metal hooks to a harness like that of a parachute. The device supports up to 800 pounds and can even be used in place of a scaffold.



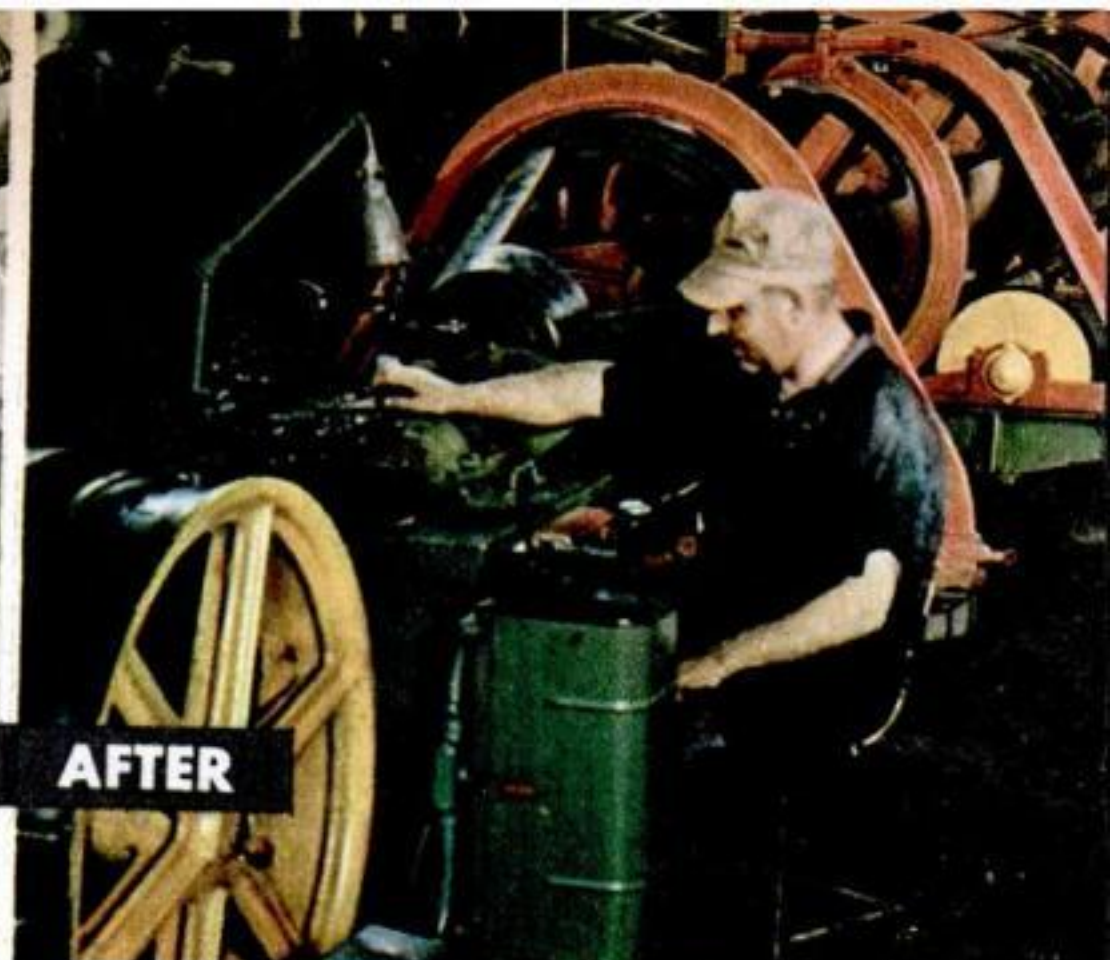
Above, Frankel demonstrates a "side-slip," made safe with his invention. At right, on the upper end of a slipping scaffold, he proves to the photographer that his device really can be a lifesaver.







**BEFORE**



**AFTER**

This wire-rope machine shows how color can make machinery more attractive—and more efficient.

# Color Punches the Time Clock

**By Lloyd Stouffer**

**G**IRLS in a carefully air-conditioned Midwestern factory complained of feeling cold, although the temperature was kept at a steady 72°. When the blue-green walls were repainted a warm coral color, however, their complaints ceased promptly. In another plant, workers lifting black metal boxes filled with rough-cut brier pipes complained that they strained their backs. One weekend the foreman had all the boxes painted a pale green. On Monday several men said to the boss: "Say, these new lightweight boxes make a real difference."

Such evidences of the deceptive and per-

suasive powers of color are not new to science. The average person will underestimate the temperature of a blue room and overestimate the temperature of a red room, and will judge dark-colored objects to be heavier and light-colored objects lighter than they really are. In the last 10 years, with the growth of a new profession called color engineering, these and other color phenomena have been put to practical work on a broad scale.

The idea that colors on the red side of the spectrum are warm and stimulating, while those at the opposite blue-green end are cool and relaxing, is accepted as a rule-of-thumb by all color practitioners. In a

124 POPULAR SCIENCE

Du Pont's Safety Color Code is used to tag industrial equipment for safety and good housekeeping.

**FIRE PROTECTION  
RED**



=



**SAFETY  
GREEN**



=





**Color works for a living**  
**in industry, in public health**  
**and in salesmanship.**



Dark box seems lighter when painted light green.



Navy's change to white shirts foiled mosquitoes.



Red speeds customers' choice, booms premium gas.

chain of restaurants, waiting lines formed outside telephone booths. When each booth interior was painted bright red, conversations speeded up so that the signs asking users to be brief were removed.

Another group of restaurants in New York adopted their striking red-and-yellow color scheme on the advice of a color consultant. Originally a chaste gray-green, the restaurants were popular, but patrons were inclined to linger and the turnover wasn't fast enough to suit the management. When the decorating was changed to stimulating colors, traffic speeded up and business increased.

Tests have established that red seems to have the edge in any selling job where a snap decision is involved. Howard Ketcham, a leading color engineer, was asked by a large oil company to try to increase the sales of its premium gasoline by changing the color scheme of its filling stations. Experimenting with a Brooklyn station, Ketcham used green and white everywhere except on the premium gasoline pump, which he painted a brilliant red. Sales for the redecorated station as a whole promptly went up 15 percent—and the premium gasoline pump sold 50 percent more than formerly.

While red impels to action, green—the color of nature—seems to promote a sense of well-being. Blackfriars Bridge, in Lon-

don, was notorious for suicides. When its black ironwork was repainted bright green, suicides from the bridge declined by more than one-third.

Though most animals, including bulls, are color-blind, color has its effects on certain insects. Blue appears to be repugnant to flies. Recently a Chicago cheese manufacturer painted a large factory window blue, to screen out the sun's ultraviolet rays; it was discovered incidentally that flies no longer congregated outside this window, although they were as thick as ever around other windows. Mosquitoes, however, seem to like blue. During the war the Navy withdrew blue shirts from men working at shore installations in malarial districts and substituted white, after tests showed that the incidence of mosquito bites was considerably higher among men wearing blue.

**Bugs and Barnacles**

Mosquitoes and other night-flying insects are also repelled by a new deep-orange electric light bulb for outdoor illumination.

Ship owners stand to save millions of dollars because of the discovery that barnacles, the marine organisms that foul ships by attaching themselves to hulls, are color-conscious. Experiments by the Scripps Institution of Oceanography show that barnacles are particularly fond of the dark colors customarily used on ship bottoms,

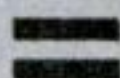
JUNE 1947 125

Used in many Army units, Color Code also employs symbols for the benefit of color-blind persons.

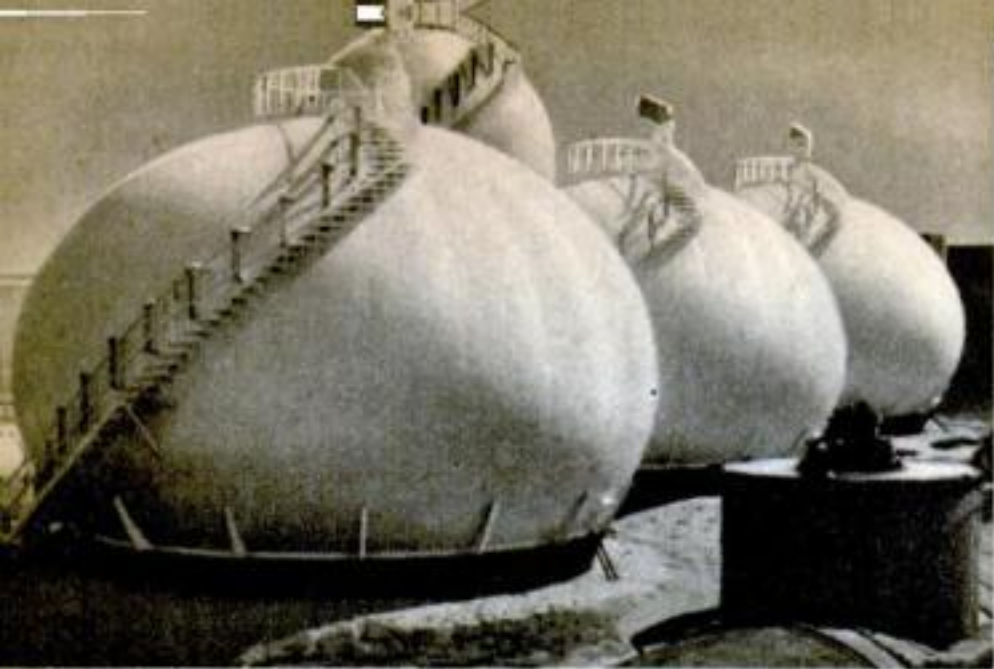
HIGH VISIBILITY  
YELLOW



TRAFFIC  
WHITE







Painting fuel tanks with special pigment—Du Pont's Dulux White—lowered temperatures and increased yearly capacity by cutting evaporation losses.

and settle in far fewer numbers on a surface painted light green or white—a simple way to decrease American shipping's \$100,000,000 annual "barnacle bill."

Wartime experience developed a complete color program for industry, with results so impressive that hundreds of factories are taking it up. Here the purpose is not merely to stimulate or soothe the worker, but to increase visibility by means of color contrast and more profitable use of illumination. Factory managers report production increases of 15 to 30 percent, which they attribute solely to the scientific selection of the proper colors in routine factory painting.

The typical steel-working plant has the bodies of machines painted a light "horizon" gray, while working areas are a cream color, to make the steel being worked on stand out in three-dimensional contrast. The ceiling is white, and the walls and supporting columns, up to a height of about eight feet, are a soft gray-green. The floor may be a light buff or gray. Fire-fighting equipment is painted red; first-aid boxes, green. Hazards—low beams, edges of platforms and pits, crane hooks and lift trucks—are yellow striped with black; switch boxes and levers, blue.

### *Saving Illumination*

The over-all effect of this industrial color scheme, fathered by color engineer Faber Birren, is harmonious and pleasing. But it has nothing to do with aesthetics, is strictly functional. Data show that with this use of color it is possible to recover light otherwise wasted and increase the actual illumination 100 percent without changing the lighting equipment or increasing the wattage. The Cambridge Instrument Co., of Ossining, N. Y., says that as a result of color-conditioning it experienced immediate gains of 15 percent in production and 40 percent in accuracy—along with a 60 percent decrease in absenteeism. And workers

take more pride in caring for equipment.

A large Detroit firm reported that in 60 days it had saved, through recovery of small parts formerly dropped and swept away, enough to pay for the painting.

Accident rates in newly color-conditioned plants usually take a sharp drop and stay down. Typical drops reported range from 20 percent (Tulsa Boiler & Machinery Co.) to 40 percent (Bliss & Laughlin, Inc., Buffalo, makers of metal-working machinery). Frequently eyestrain, which can create dangerous fatigue and nervous tension, is the result of constant, involuntary adjustment of the eye muscles caused by wrong color contrast, or distracting, glaring horizon colors, even where there is sufficient light.

In the inspection room of a North Carolina textile mill, girl operators scan blue denim hour after hour, as it moves rapidly under their eyes. Thinking to provide the maximum light, the operators of the mill had painted the walls of the room white. But when the girls looked up momentarily from the blue cloth to the white wall for a rest, a peach color swam before their eyes.

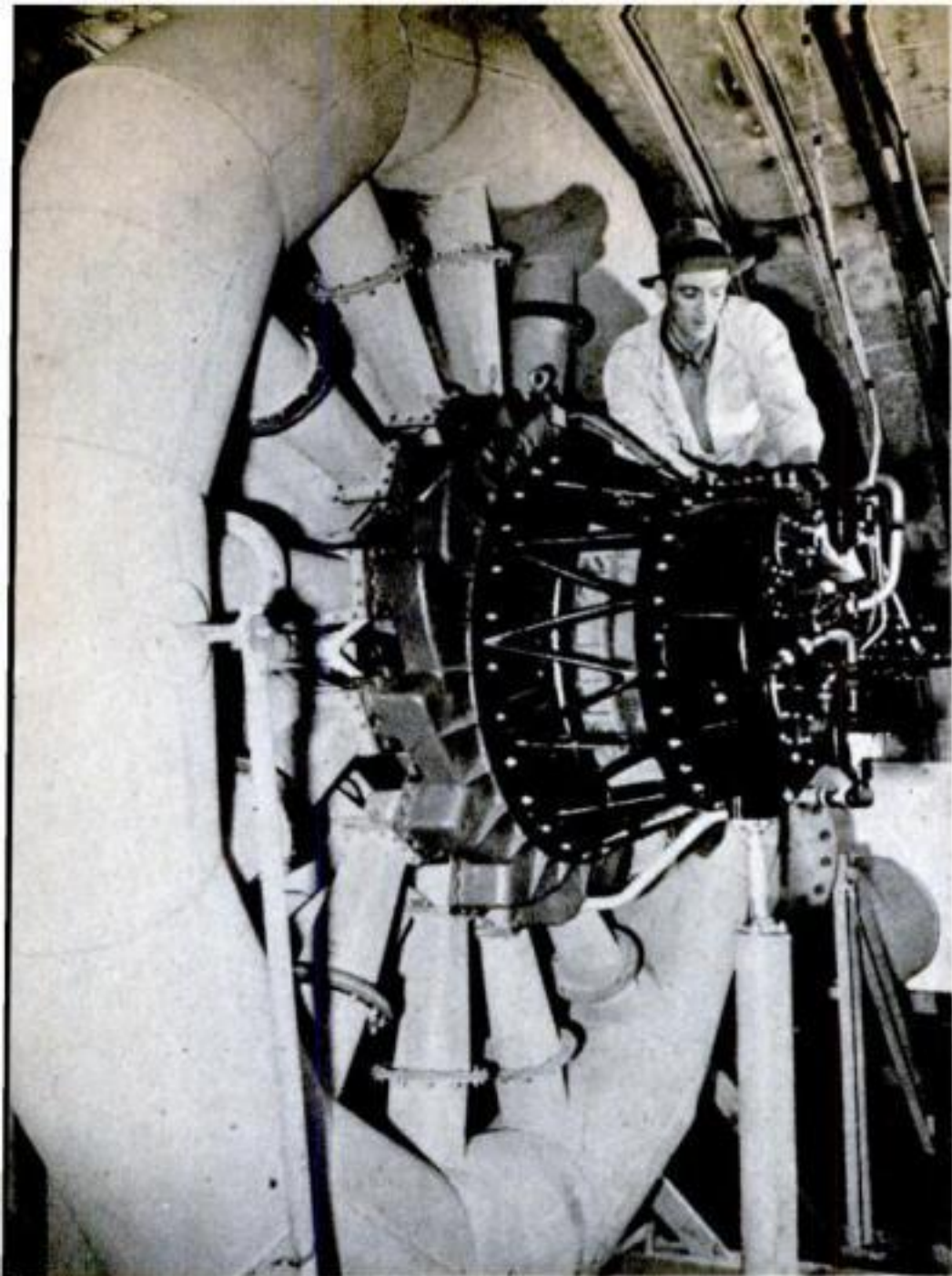
### *The Eye's Defense*

This is the visual phenomenon called "after-image": The human eye, overstimulated by one color, registers the opposite or complementary color as a means of readjustment. When the girls looked back at the work, it took them several seconds to regain normal vision. A color engineer greatly increased the time the girls could work effectively and without strain at this job by providing what their eyes demanded: peach-colored walls.

Color engineering performs some of its most powerful functions not with bright hues, however, but with pure black and white. Here the effect is strictly physical, based on the fact that black absorbs heat and white repels it. The Beech-Nut Packing Co., at Canajoharie, N. Y., paints the black tar roof of its plant white each spring with a short-lived water emulsion paint, lowering plant temperatures through the hottest part of the summer by several degrees. By the time cold weather comes, the white paint has weathered off and the plant gets the full benefit of the heat-absorbing black roof. And heating engineers have found that a five-coil steam radiator painted white will produce as much heat as six coils painted a dark or metallic color.

The basic principles of all colors have been known to us ever since Sir Isaac Newton looked through a glass prism and discovered the spectrum. But because we have been blinded by color's aesthetic appeal, we have overlooked its amazing powers, and only recently have put it to work. **END**

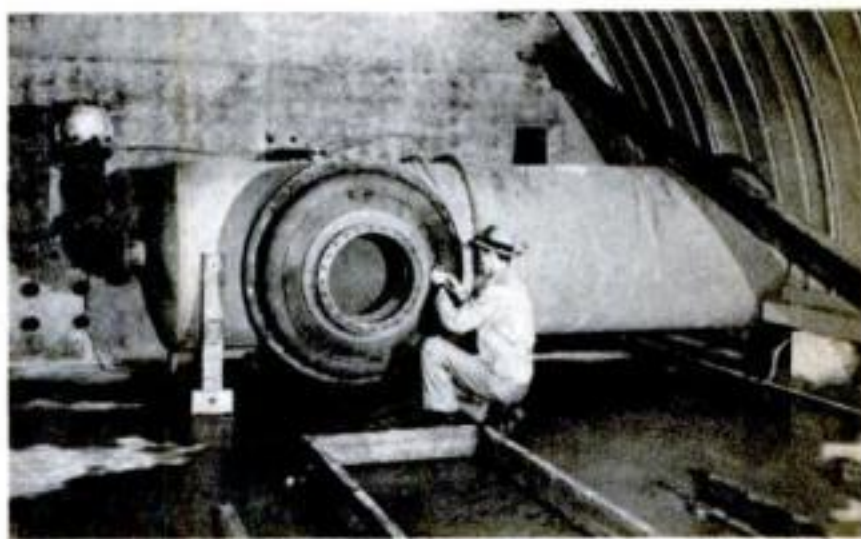




This modified I-40 jet engine, steam operated, is being checked before being used to compress air for operation of the ram-jet engines.

## Steam Runs Jet

MAN'S first artificial power source has been put to work running his latest engine. Steam has been piped into the Boeing plant at Renton, Wash., and operates a modified I-40 jet engine. The jet in turn compresses air to produce a stream, traveling at supersonic speeds, used for laboratory testing of high-speed ram-jets, part of an extensive AAF program on new power plants. Combustion testing is conducted in a special "thermodynamic" wind tunnel. The steam comes from a 107,000-horsepower steam electric plant near by.



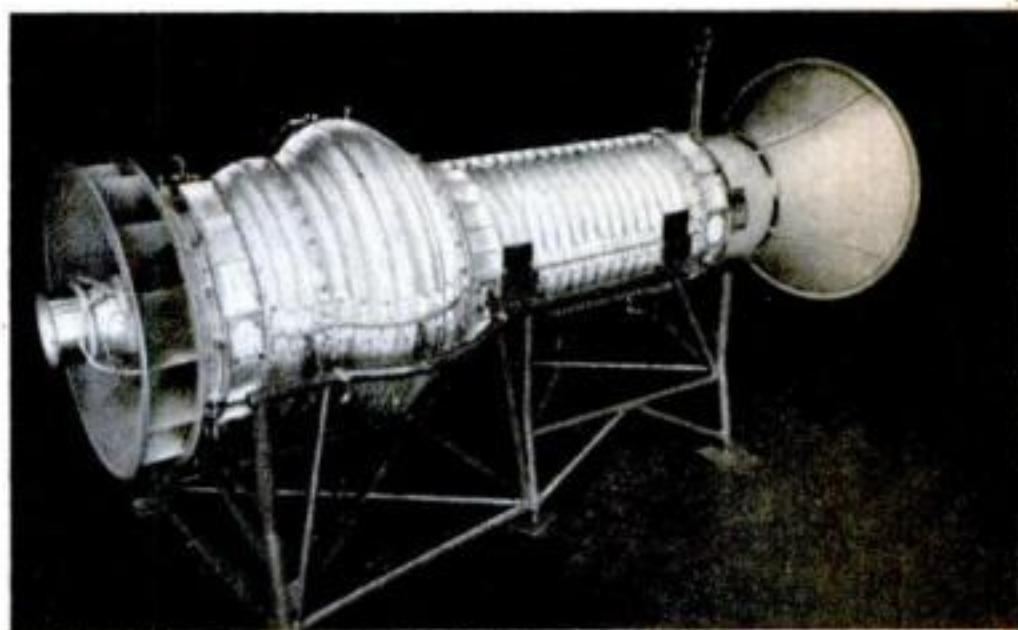
In the test cell, workmen give final touches to the duct that carries supersonic air stream to experimental ram-jets undergoing tests.

## Turbodyne

THIS slender engine, the Turbodyne, is said to deliver the greatest thrust ever created by a gas turbine. Built for the AAF by the Northrop-Hendy Co., of Hawthorne, Calif., it is part of a seven-year research project that until now has been secret.

The Turbodyne is designed to run about 500 hours with the temperature at the nozzle blades 1,400° F., operating with a combustion efficiency of 94-96 percent and a compression ratio of seven to one. At lower speeds, it will run 10,000 hours. As the engine turns faster than 10,500 r.p.m., a centrifugal force of 20,000 Gs is developed.

The air is sucked in and compressed by more than 1,000 blades, shaped like airfoils, mounted on one end of the main shaft. The air then moves at high pressure to the center of the engine, where it is mixed with fuel. The engine burns a variety of fuels, including kerosene, 100-octane gasoline and pulverized coal. The fuel-air mixture ignites like a gigantic blowtorch, its fiery blast driving against the turbine blades to spin the shaft.



Air enters bell-like mouth at right and is compressed by hundreds of tiny blades. It is then mixed with fuel in the combustion chamber—the bulge just left of center. The turbine spun by the fiery mixture is at the extreme left. Projecting from the intake are pressure tubes and temperature indicators, used in checking the engine during tests. The shaft extends through the engine.

Studies of the possible use of the Turbodyne to power locomotives are now being made by the Northrop-Hendy Co. in co-operation with the Union Pacific Railroad.



# CRAFTWORK

PROJECTS OF THE MONTH



**RUBBER-BAND CHAMP.** Put your name on this plane before you let it take off, because the *Chieftain* may well fly out of sight. Its sleek fuselage is made of hollowed balsa and houses a retractable land-

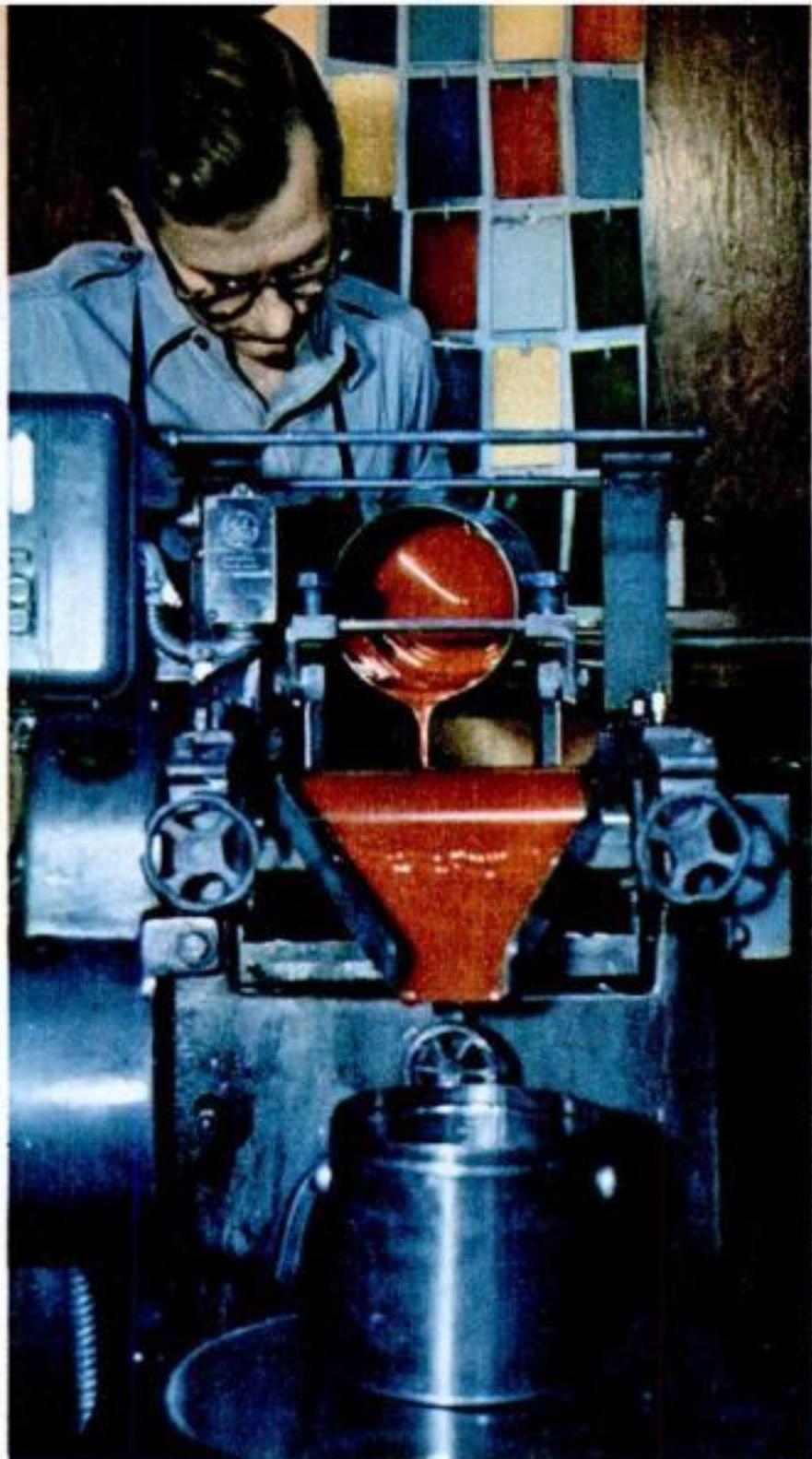
ing gear; a counterbalanced prop folds back for a smooth, flat glide. If you want to see thrilling performance on rubber-band power, build this sleek, clean-lined job from the plans beginning on page 170.

**MINIATURE JET CAR.** Carbon dioxide cartridges that put sparkle and life into soda-water siphons also pack a completely different kind of excitement. Such a cartridge is tucked into the tail of this other-

worldly car. When it is punctured to let the gas stream out, the escaping jet will rocket the tiny balsa racer at speeds up to 50 m.p.h. If you'd like to try whizzing on fizz, turn to page 166.







A laboratory technician operates a three-roller paint mill to grind pigments for an A-resin product. Resin is the family name for the principal film-forming ingredients in varnishes and enamels.

# New Paints from Oil

**O**RGANIC chemists are the Scotchmen of science. They won't waste any raw material, especially if it is cheap. The latest reward of their ingenious frugality is a new resin for paints, made from the petroleum hydrocarbons that were a basic ingredient of wartime synthetic rubber.

Called A-resin by Esso Laboratory chemists who developed it, the new synthetic makes paints, enamels and varnishes reported to be superior in some respects to existing finishes. They stick well to almost any surface, even highly polished metal. A-resin paints will not flake off, the makers assert, pointing out that a knife scratch pulls pieces of metal away with the paint.

In other characteristics, A-resin paints are also said to rank high. They resist soap and water, withstand weathering, and are not dissolved even by acid grapefruit juice;



Checking test samples of A-resin finishes in a Fade-Ometer, which gives accelerated ultraviolet light and heat breakdown of paints and varnishes, simulating the effects of natural sunlight.



Supplementing the ultraviolet test, experimental panels are subjected to actual weather exposure to see how well they stand up. A-resin finishes are said to dry quickly and provide a lasting gloss.



these qualities are expected to make them useful for coatings for food cans (which must be unaffected by stamping operations and by the acidity of their contents) and for the priming coat on autos. Of major interest to paint manufacturers is the fact that A-resin is a "short-oil-length" resin; it requires mixing with only small quantities of drying oils, such as linseed or tung oil.

A-resin enamels may find wide use for such everyday jobs as refinishing furniture. They dry quickly, leave no brush marks, and are expected to be fairly low in cost.

### Atomic Architecture

Back of this development are several years of atom-juggling based on previous experience at changing oil into almost anything man can use. Starting with pure hydrocarbons (compounds containing only the elements hydrogen and carbon), chemists had already rearranged the atoms and the connections between molecules to make rubber.

The researchers went back to the same raw material — hydrocarbons — and once more rearranged atoms and linkages. This time they wanted not a soft, stretchable material like rubber, but something hard and brittle. It would have to be insoluble in water, but soluble in certain hot oils. More important, it would have to dry into a tough, lasting film. The result of this atomic architecture, A-resin, is soon to be produced in experimental quantities at a pilot plant in Bayway, N. J.

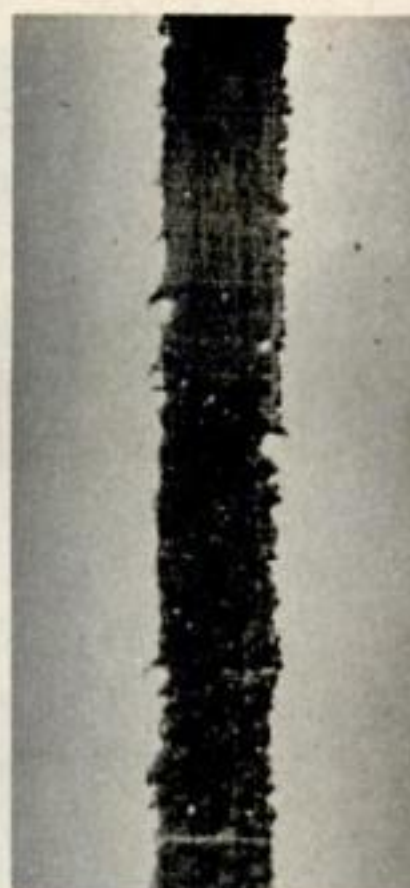
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A chunk of A-resin, placed on a dictionary page, indicates the synthetic's purity. This gives it the light color required by paint and varnish makers.



A scratch hardness tester measures the resistance of dried paint and varnish surfaces. Comparative results obtained with ordinary enamel and its A-resin equivalent are shown in photo at right.



Magnified scratches on equally thick coatings of two enamels show the flaking of ordinary enamel, on the left, and emphasize the greater adhesive properties of the A-resin product on the right.





## Mine-killing Snake

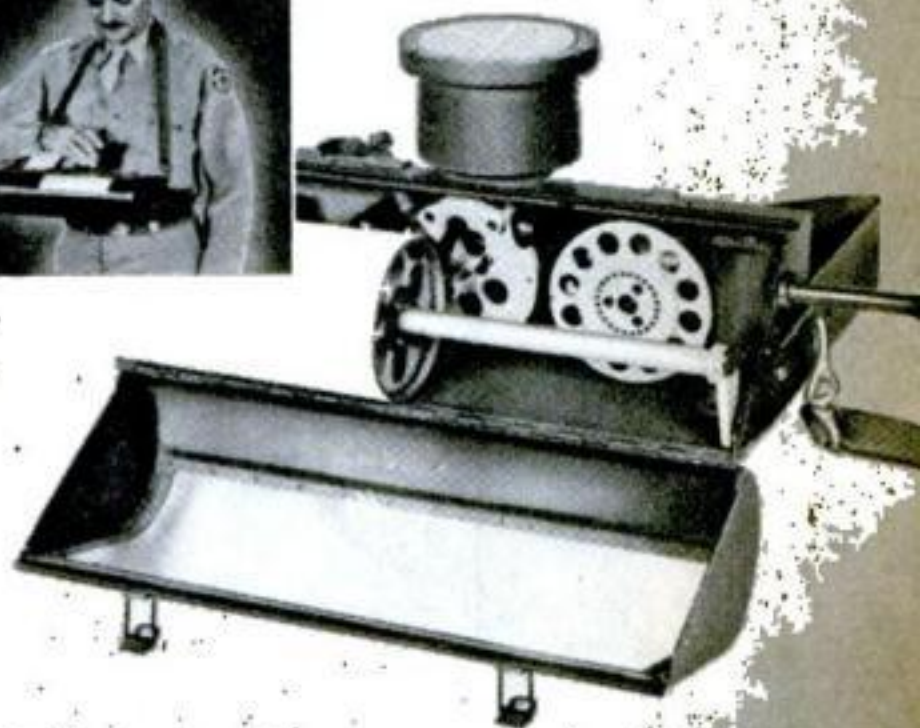
THIS rocket-headed "snake," slithering across the water at 90 m.p.h., is a mine killer. Launched from an assault boat, it swooshes to an enemy-held beach, climbs onto it—and blows itself up. The blast from

its 45-foot, explosive-packed tail (most of it hidden by smoke in photo above) sets off any enemy mines planted on the beach to keep attackers from landing there. Similar rocket-powered devices have been developed, also by the Army Engineer Center, Fort Belvoir, Va., for use ashore.



## Spike Detector

THE veteran mine detector has a civilian job—ferreting out nails in logs. Saboteur-driven spikes splintered dangerously when they hit the saws of R. T. Mitchell's mill at Logansville, Ga., so he obtained special authority to buy a detector.



## Logs Walkers' Course

WITH this pedograph slung around his neck, a man always knows where he is and where he's been. Developed by Army Engineers for marching troops, the device makes a continuous record of directions and distances traveled. Close-up shows details.





# Dipping Clear Plastic into the Rainbow

**C**RYSTAL plastic has a beauty peculiarly its own, but the craftsman can now dip into the dyemaker's palette to give it any hue he wishes. Lucite, plexiglas, cellulose acetate, vinylite and polystyrene can be colored simply by dipping into a hot dye solution. The materials needed are inexpensive and the process takes only a few minutes.

Several water-soluble plastic dyes are being marketed for this purpose. These are offered in a wide choice of colors—sky blue, royal blue, turquoise, yellow, orange, scarlet, magenta, purple, green, amber, brown, red, ruby, violet and black. Some common aniline dyes also may be diluted with water for use in the same way, and you may find it interesting to experiment with a few of these.

Immersion dyes are sold in concentrated liquid form. This is diluted with 10 parts of water and then heated until the solution is just barely at the simmering stage, or about 190 to 200° F. The plastic to be dyed should first be carefully washed with alcohol to remove any oils or grease. How long you should submerge it in the dye will depend on the depth of tone you want, but usually won't exceed 60 seconds. Immediately after removal, rinse the plastic in cold water. Colors imparted to plastics in this way will not wash off.

Two or three dyes of the primary colors will enable you to produce many of the other colors. Simply dip the plastic into separate baths of the primary colors.

PSM photos by W. W. MORRIS





Sold as a concentrated liquid, this plastic dye is first diluted with 10 parts of water. Here the container is a heat-resistant glass beaker, but for flat work the dye may be placed in a shallow metal receptacle like a pie pan.



Before dyeing a piece of plastic, grasp it with a pair of tongs and carefully swab all surfaces with alcohol to remove any dirt and grease that may impair the action of the dye. Do not touch the plastic thereafter with your bare fingers.



Heat the bath to just simmering (200° F.), and dip the plastic for a period up to 60 seconds, depending on the depth of tone that is desired. If bent plastic is left in too long or the dye becomes too hot, the piece may straighten.

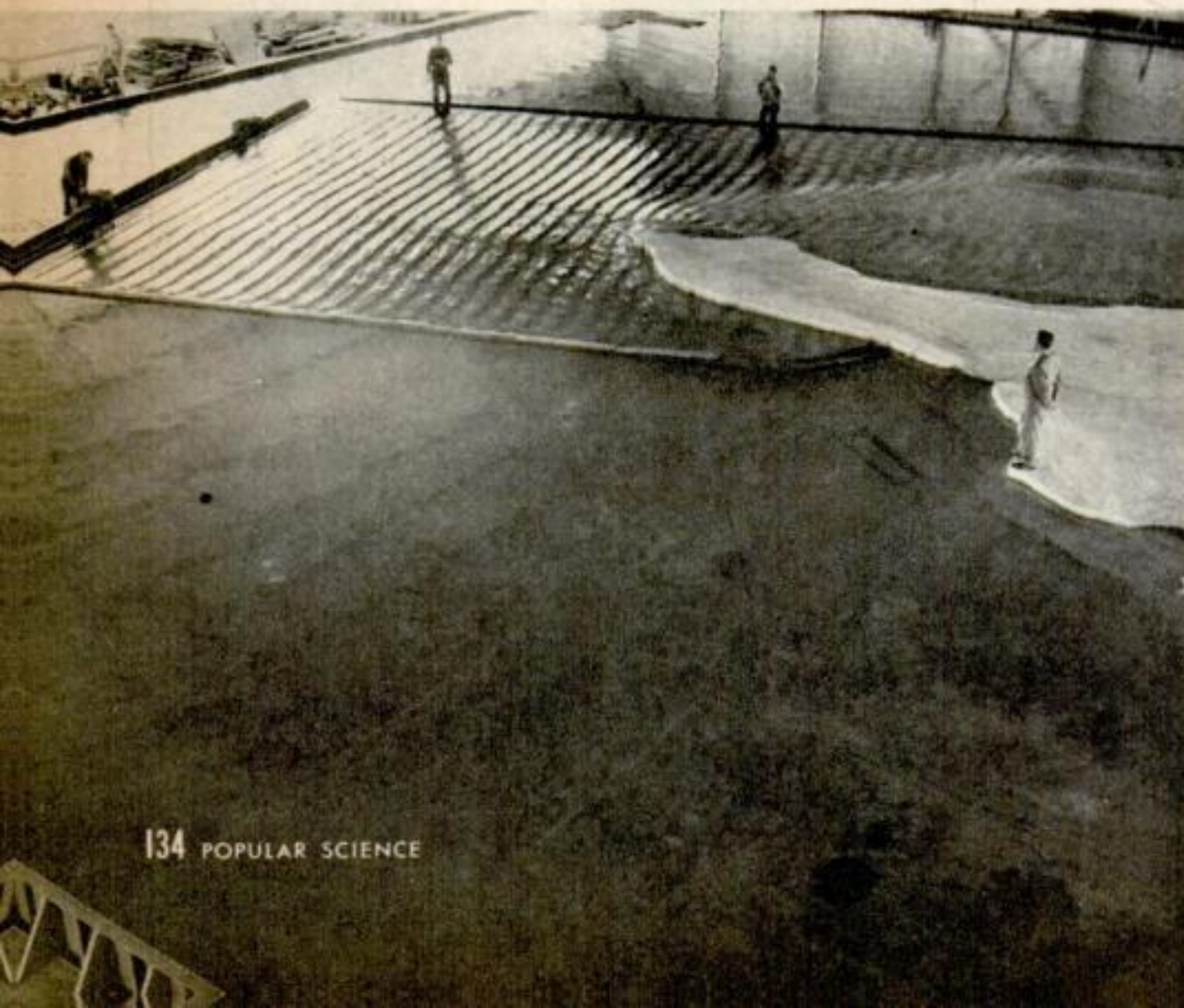


Remove the dyed plastic from the bath and rinse it immediately in cold water. Plastic dyed in this way is color-fast and may be heated and shaped after dyeing if you prefer. The dye will wash easily from the container.





# Hurricanes Harnessed in



ABOVE: Seven miles of Guam coastline and Apra harbor are compressed within this 120-foot-square model built for the Navy's Bureau of Yards and Docks. The cliff on which the man is standing is actually 220 feet high on the Pacific isle.

The wave machines, with their 20-foot-long air chamber (upper left-hand corner), produce tiny wavelets that represent ocean waves from  $7\frac{1}{2}$  to  $22\frac{1}{2}$  feet high. Sidebars prevent the waves from spreading.



**M**INIATURE storms, raging in an airplane hangar among the orange groves at Azusa, Calif., are sending waves no taller than a thumbtack beating against a model of Guam's Apra harbor. By studying the behavior and effects of these baby breakers, scientists are building a defense against typhoon damage to the Navy's proposed new permanent base on this important outpost in the Pacific.

Built of steel and concrete to a scale of one to 300, the model of Guam's harbor is 120 feet square and partially surrounded by water. Special pneumatic machines designed by Dr. Robert T. Knapp, California Institute of Technology engineer, produce miniature waves from one-quarter to three-quarters of an inch in height.

The motor-driven, valve-controlled machines alternately supply pressure and vacuum to a 20-foot-long air chamber, kicking and sucking the water under the chamber to produce the wave effect. A differential generator regulates the height and frequency of the waves.

Fluctuation of the waves is recorded continuously at 17 different points in the water surrounding the model by thin spring-steel wires, alternately coated with three layers of silver and two of gold. Variations in the electrical resistance of these wires, as the water rises and recedes, are translated by a galvanometer-type oscillograph into a

# a Hangar

moving photograph of 17 wavy lines duplicating the water's movement.

To make certain that the studies cover the latest facts about the harbor site, measurements of wave heights and directions, current velocities, and other conditions of wind and water at Guam are collected regularly by the Navy.

From these studies will come data for the placement of slips, docks and drydocks, the position of the breakwater's outer limit, and the solution of the harbor's cleansing problem, including changes in the Agat drainage channel and the Pite boat channel.

The \$275,000 model will save millions, the Navy hopes, in the actual Guam project, expected to cost \$1,000,000,000.

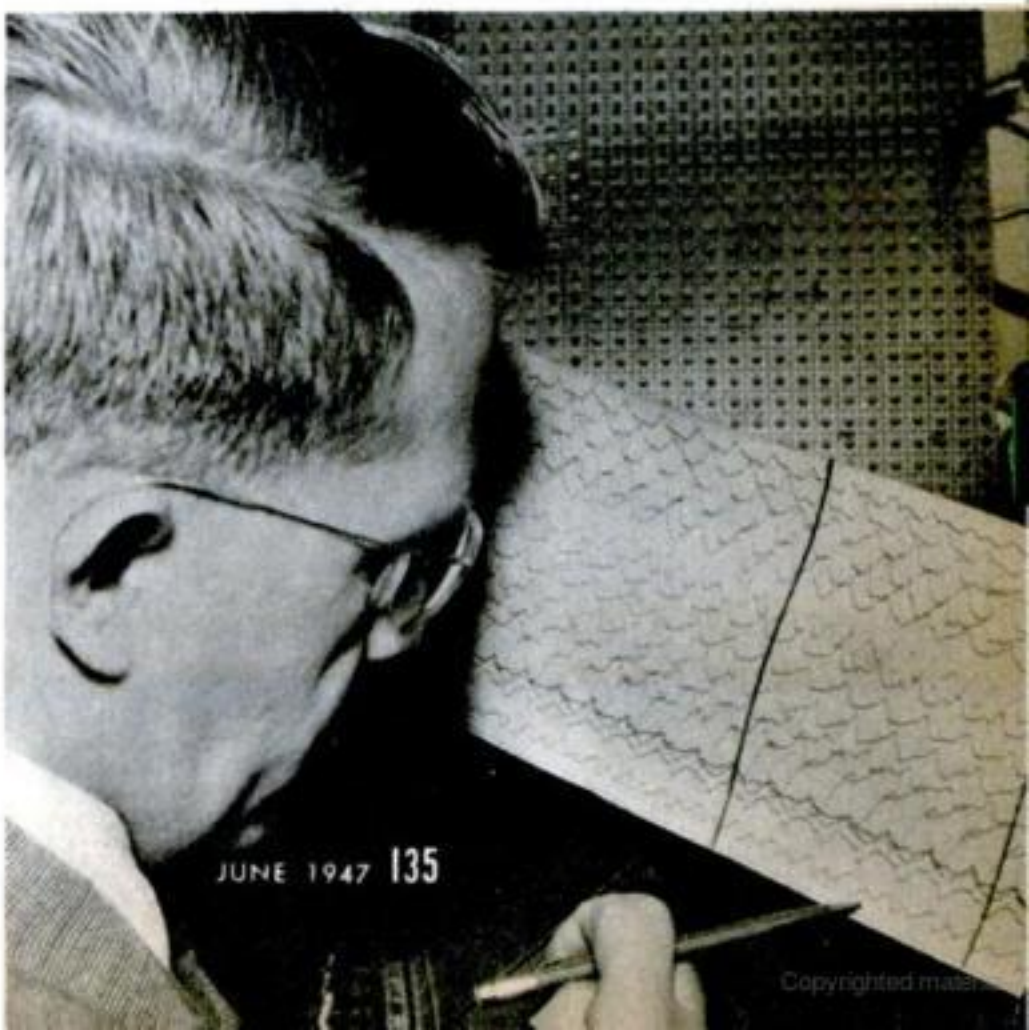
Wavy lines record the motion of the water on a continuous chart. Space between the heavy lines represents three seconds; taller fluctuations, 30-foot waves, occurring at Guam every 15 years.



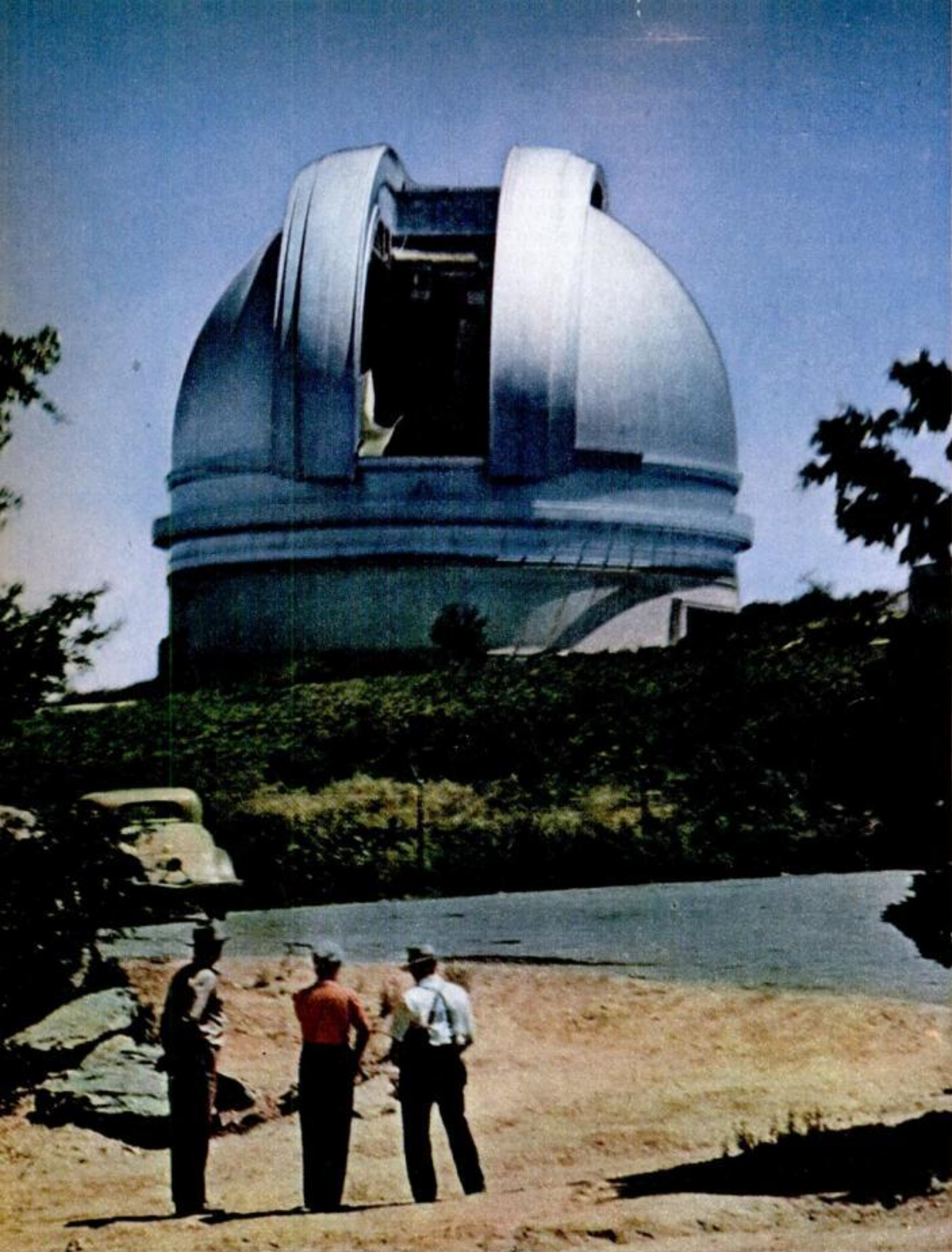
The pneumatic machine, above, operates the compression and vacuum chamber, which forces water in and out of the bottom through narrow ports to produce the required waves.



Movements of the miniature waves are measured simultaneously at 17 points by resistance elements like the one above. Tiny boat in the center of the photo represents a 60-foot tug.







## ***Gateway to the Universe***

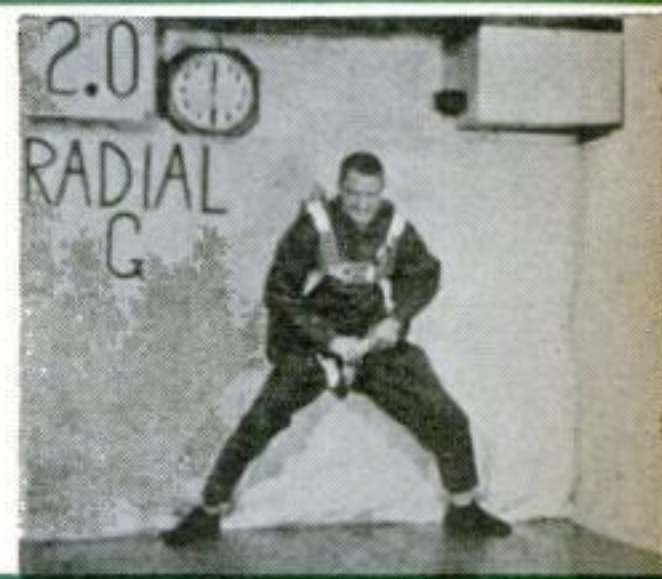
THROUGH this huge dome, sometime early next year, the giant telescope built by the California Institute of Technology will focus its 200-inch eye for the first time on stars as far away as a billion light years.

Twenty years of planning and construction have gone into the \$6,000,000 project atop Mount Palomar. Its telescope is expected to allow astronomers to peer four times farther into space than ever before.





AT NORMAL GRAVITATION



AT 2G GRAVITATION



AT 3G GRAVITATION

Photos from *Journal of the Aeronautical Sciences*.

Tests in centrifuge show pilot easily donning his 'chute in 15 seconds at normal gravitation. At 2 G

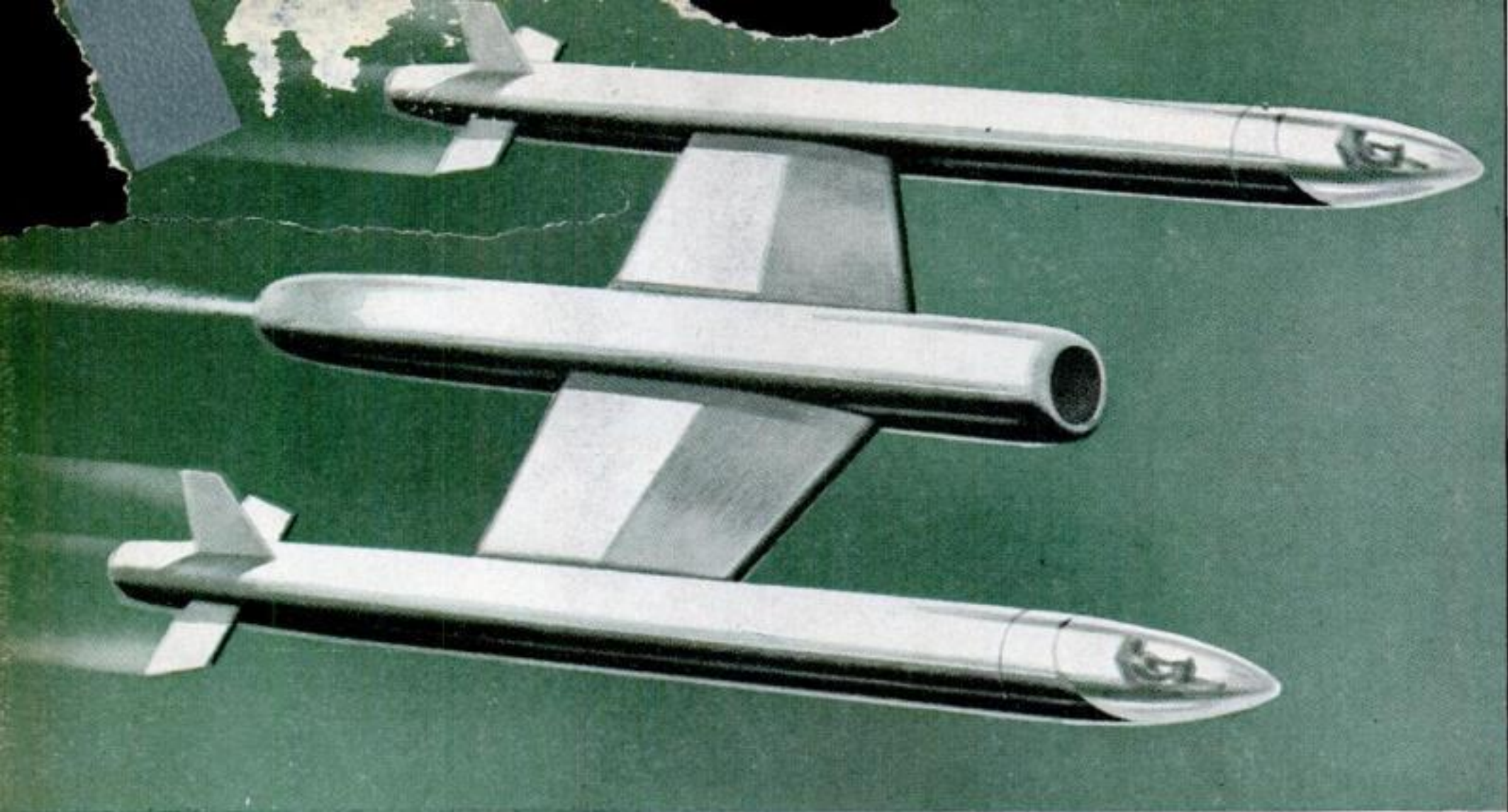
the job takes 30 seconds; at 3 G, it is a 50-second struggle. Under 4-G stress it would be impossible.

## Superspeed Needs Supermen

MAN'S brain has devised planes that can fly faster than the speed of sound, but he has not yet been able to condition his body to take the physical tortures and impact of supersonic flight. And since we are too impatient to wait for evolution to develop sturdier bodies, the solution lies in neutralizing or minimizing the effects of flight at 1,000 and more miles an hour.

Much of the basic research has already





Artist's conception of a supersonic airplane with large center ram-jet. Pilots sit in front of twin fuselages, which are equipped with rocket engines to supply auxiliary power if the ram-jet engine fails.

been done (PSM, Oct. '46, p. 121), but we still have a long way to go before pilots can open wide the throttles of the supersonic planes already here, like the Bell XS-1 and the Douglas Skystreak. The Navy, the AAF and civilian researchers are all working at top speed to prepare the man for the machine.

The cockpit for the supersonic pilot will

"Mach cones," opaque shock waves at supersonic speed, may require instrument flying even in clear weather. Special optical devices may also be needed.

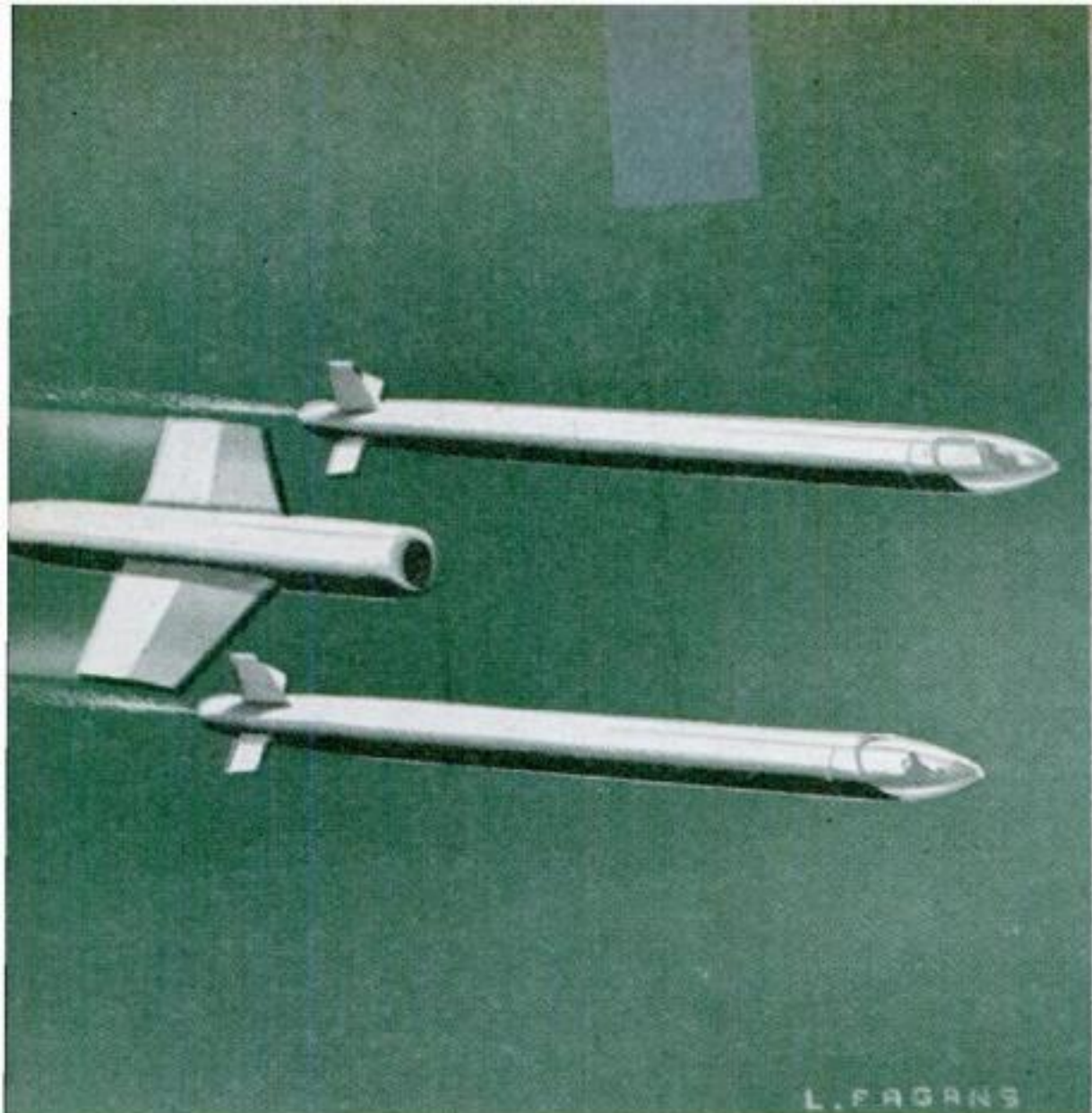


be pressurized and refrigerated against the terrific heat created by friction. It will also be soundproofed, not only to eliminate the roar of rockets and ram-jets, but to protect the flier against ultrasonic vibrations and noises above the range of hearing to which his brain centers and glands will be exposed.

Another problem is the matter of G (unit of measure of pull in any direction; the normal weight of an object or person is one G). Should the power plant of a plane flying at 1,500 miles an hour fail or lose speed, the deceleration to a coasting speed of 500 miles an hour, at the most, would be terrific. With the sturdiest seat and safety harness to hold the pilot's body firm, he would literally explode as everything inside him kept going when the plane and body stopped. One test pilot has predicted that the deceleration of a supersonic plane might involve forces as high as 100 G.

The photographs on page 137 clearly show what this would mean. These pictures, part of a report by Charles Code, Earl Wood, and Edward Lambert of the Mayo Clinic, vividly indicate what happens to a man at only 3G. They explain why a supersonic pilot must have some auxiliary power plant to continue motion if the main source of power should fail or suddenly slow down





If the plane's speed falls below safe limit, jet and wing section is jettisoned and rocket engines cut in. When the fuselages slow to safe speed, pilots pull levers to release capsule noses, then open their 'chutes.

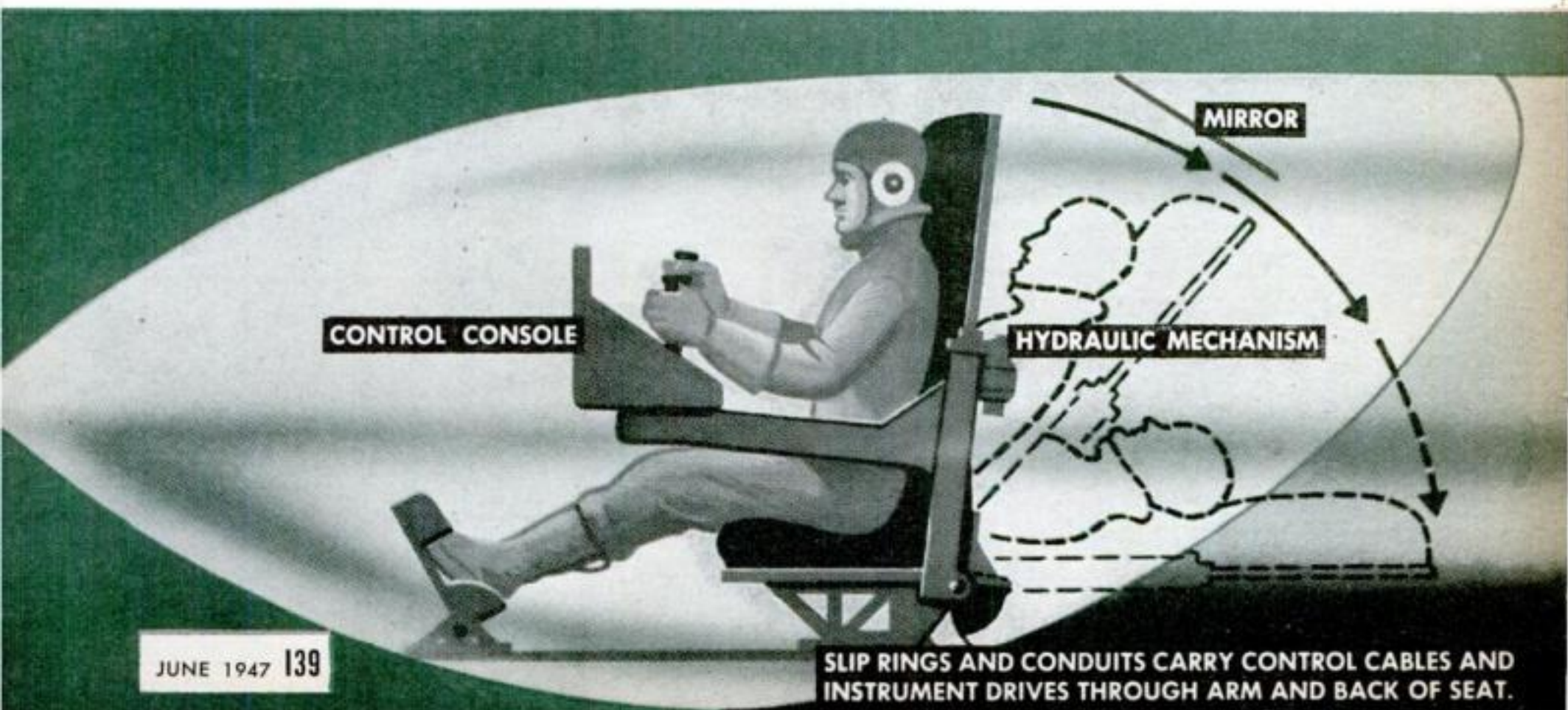
for any reason, enabling him to decelerate at a slower rate until he reaches a speed at which it is safe to parachute.

In addition to speed and sharpness of maneuvers, bodily position is also related to the effect of G forces. Experiments have shown that by lying prone, a pilot can take twice as many radial G (in turns and pull-outs) without blacking out. The force is directed through the shortest, strongest part of the body instead of traveling the airman's

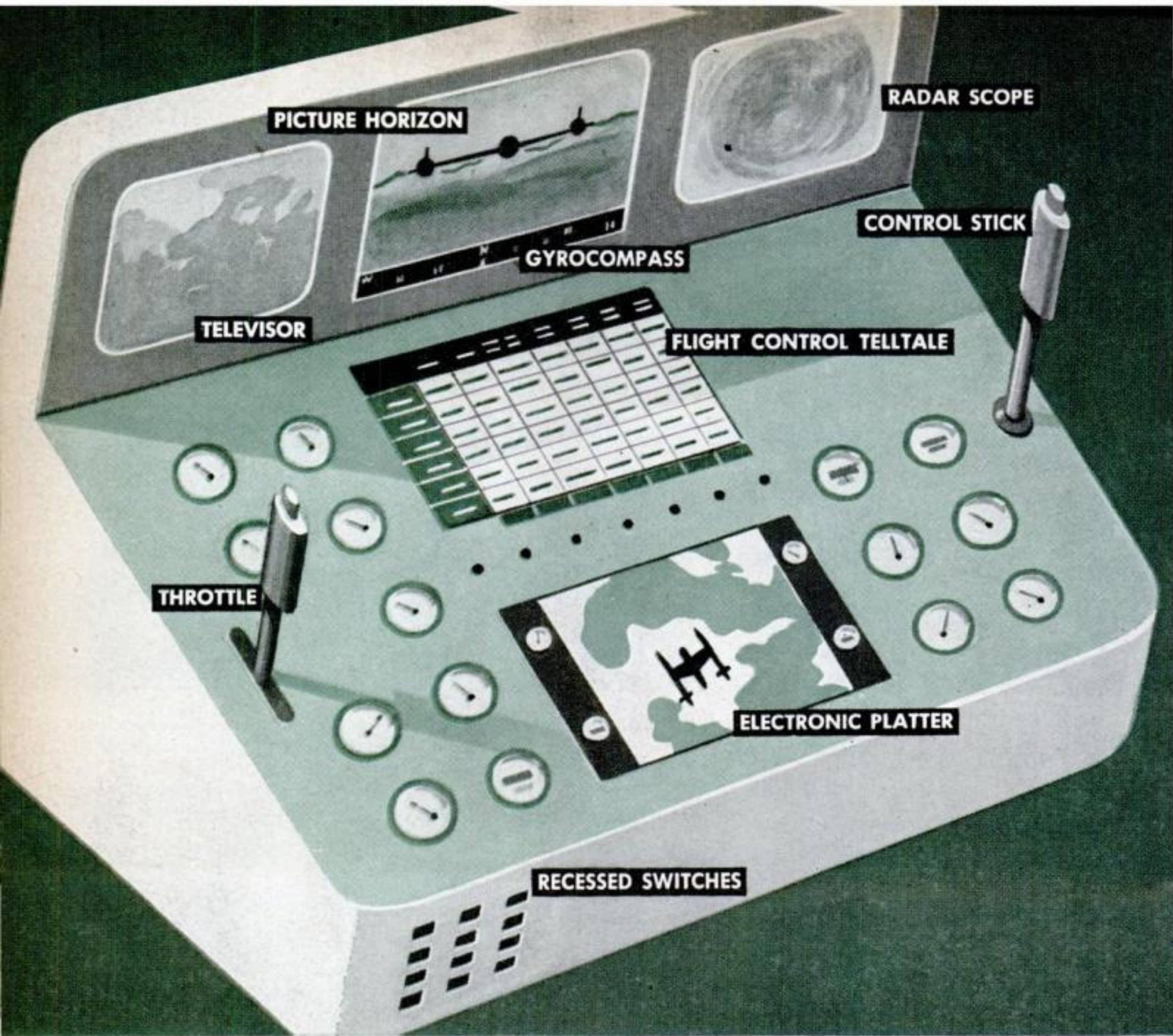
whole length. In the Northrop XP-79 flying wing and in an experimental Navy plane the pilot flies prone.

The prone position, however, is not healthy when lateral G is exerted by suddenly speeding up or slowing down. To solve this problem, the Navy has devised an automatic reclining seat. The flier sits upright during straight flight and lies supine during turns and dives. Thus, the position of the body is automatically changed so that

Automatic reclining seat protects pilots from effects of high G forces by changing position of the body.







Simplified instrument panel enables pilot to make instant adjustments needed for supersonic flight.

	KNOTS	TACHOMETER	BURNER RING FUEL PRESSURE	JET TEMPERATURE	FUEL PERCENTAGE	OIL PRESSURE	CABIN PRESSURE
TAKE-OFF	—	—	—	—	—	—	—
CLIMB	—	—	—	—	—	—	—
CRUISE	—	—	—	—	—	—	—
MAXIMUM	—	—	—	—	—	—	—
LET-DOWN	—	—	—	—	—	—	—
LAND	—	—	—	—	—	—	—
	FUNCTION TABS						

Variations in lines on the telltale panel warn pilot of any faulty operation; function tabs correct it.

the G travels through the strongest portion of the body regardless of maneuvers.

Besides protection against the brutal shocks and pressures of supersonic flight,

the pilot will need something to help him match the speed of his own reactions with the speed at which he travels. Instead of the maze of dials, levers and switches in a conventional aircraft, his control panel will have a half-dozen basic instruments to tell him at a glance how his plane is behaving. Equally simple controls will govern its performance.

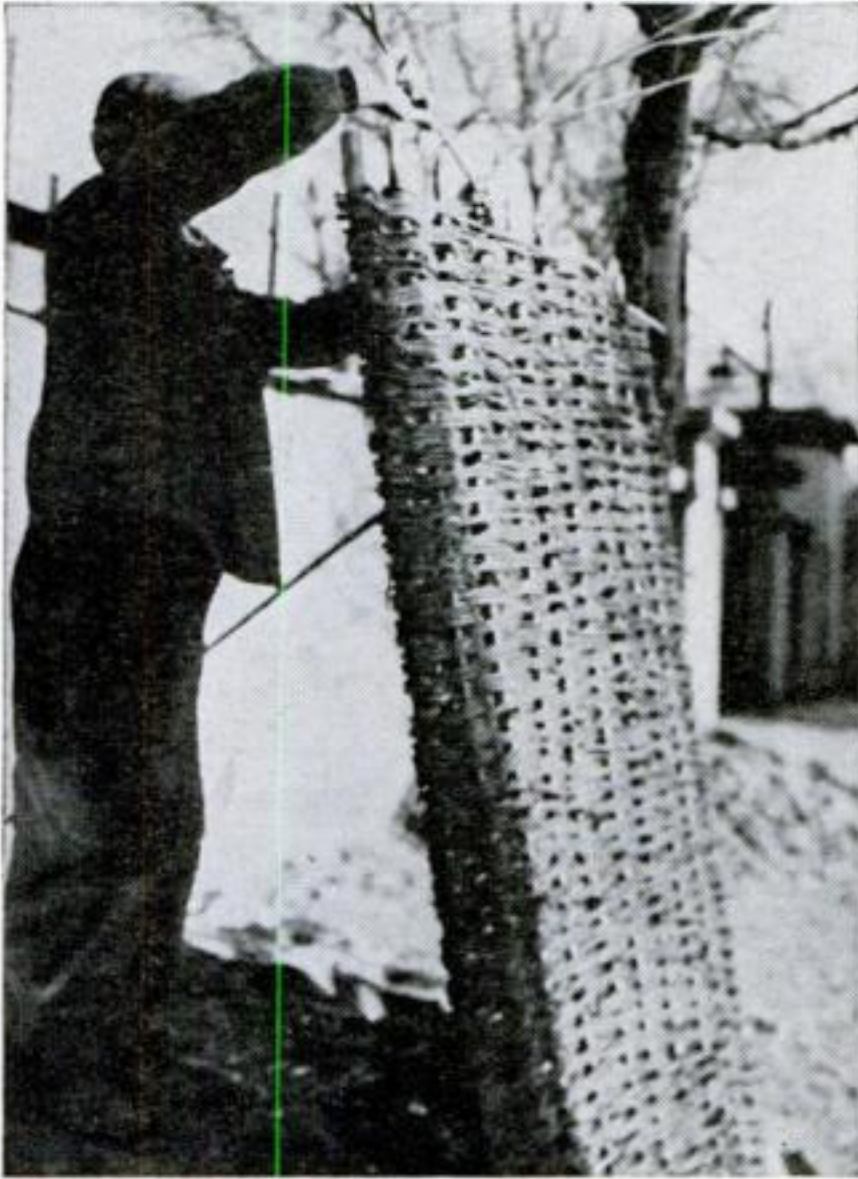
As the Wright brothers flew before we had a practical knowledge of aerodynamics, so supersonic flight may become a reality before we have all the answers. But for both humanitarian and scientific reasons, we want the pioneer supersonic pilot to return to earth alive. If he is to do that, there are a lot more answers that must be supplied before the take-off.—JAMES PECK.



## French Weave Houses

SCARCITY of ordinary materials to meet the French housing shortage has led to the modernization of one of the oldest building

methods—wattle and daub. Woven wickerwork panels, fitted into walls and plastered over, are said to be as durable as reinforced concrete. Whole wickerwork villages are reported planned for devastated areas.



Willow branches are woven in and out between sticks to make extremely light basketwork panels.



The panels are fitted into place in the walls of a partly built house. One man can carry a panel.



In a finished house, the wickerwork panels are plastered over to make a weather-resistant wall.

## Trends in Trailers

OUR own housing shortage has redoubled interest in trailers. The National Trailer Coach Exhibit in Chicago brought out a

variety of 1947 models. Shown below are a 27-foot type equipped with an awning, and a double-decker—the upper section raised by a hydraulic lift—said to be used in Hollywood as a portable dressing room.



This trailer, designed to carry six passengers, is made by the Zimmer Boat and Trailer Company.



The double-decker, built of wood and metal by the Liberty Trailer Coach Company, holds eight persons.



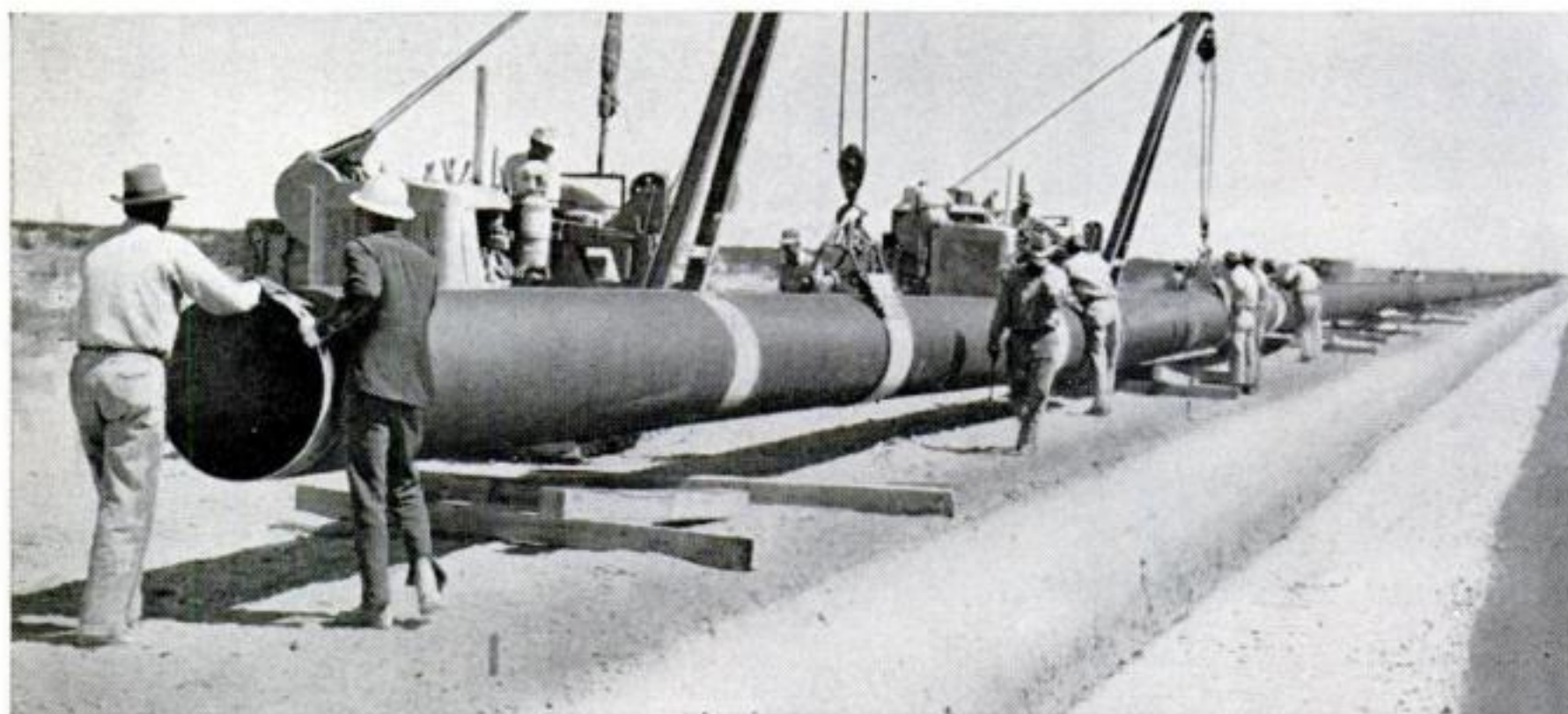


Three gas companies are co-operating in building the new pipe line. Two of them will act as distributing concerns in the area shown on the map.

# "Biggest Inch"

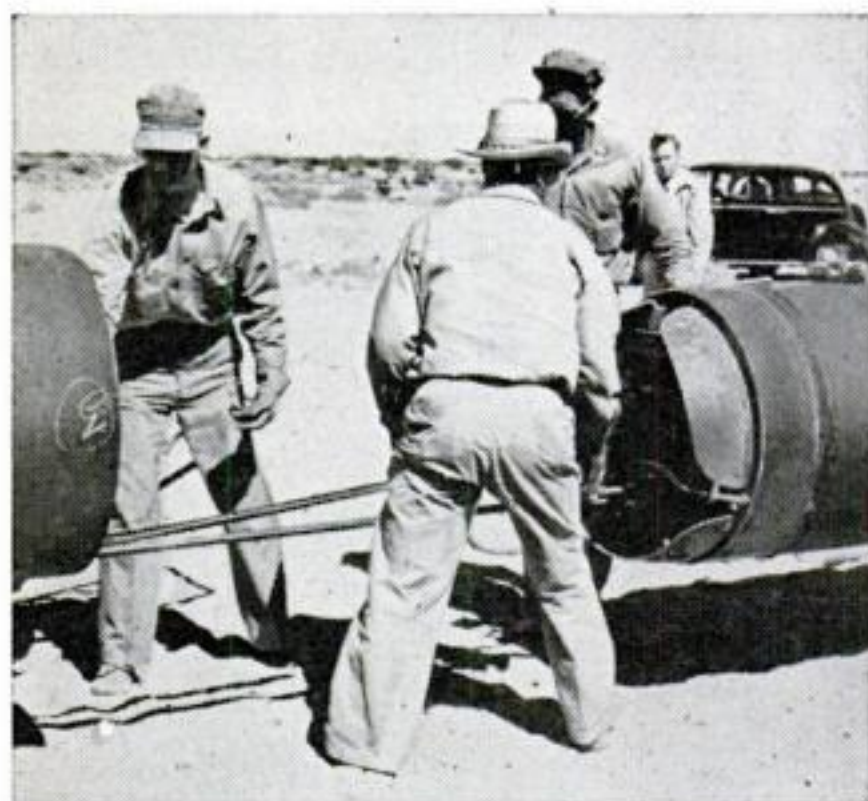
THE "biggest inch" of all is going west—from Texas 1,212 miles to the Pacific. Slung on cables high above seven rivers, diving 12 feet deep to avoid flash floods, climbing mountains and crossing deserts, the \$70,000,000 pipe line is growing five miles a day. By next winter it will be pouring 305,000,000 cubic feet of gas a day into a California pinched between swelling de-

Photos from Southern California Gas Co.



Side-boom tractor moves pipe section into place for welding; beyond, pipe is ready for lowering into trench. Here, near Blythe, diameter is 30

inches; farther east it is 26, then drops to 24, the size of the East's "Big Inch." Larger size provides extra storage equal to five big tanks.



Two sections are pulled together by interior-expansion clamp that grips them for welding. Clamp is then collapsed and moved to next joint.



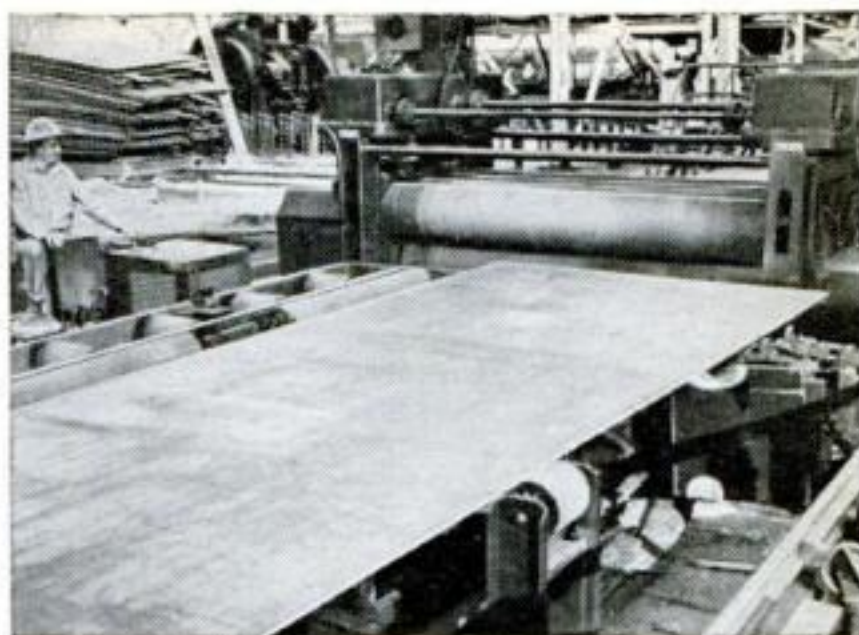
"Stovepipe" welding joins sections, three weld passes being made around each joint for a faultless bond. X-ray checks are made at intervals.



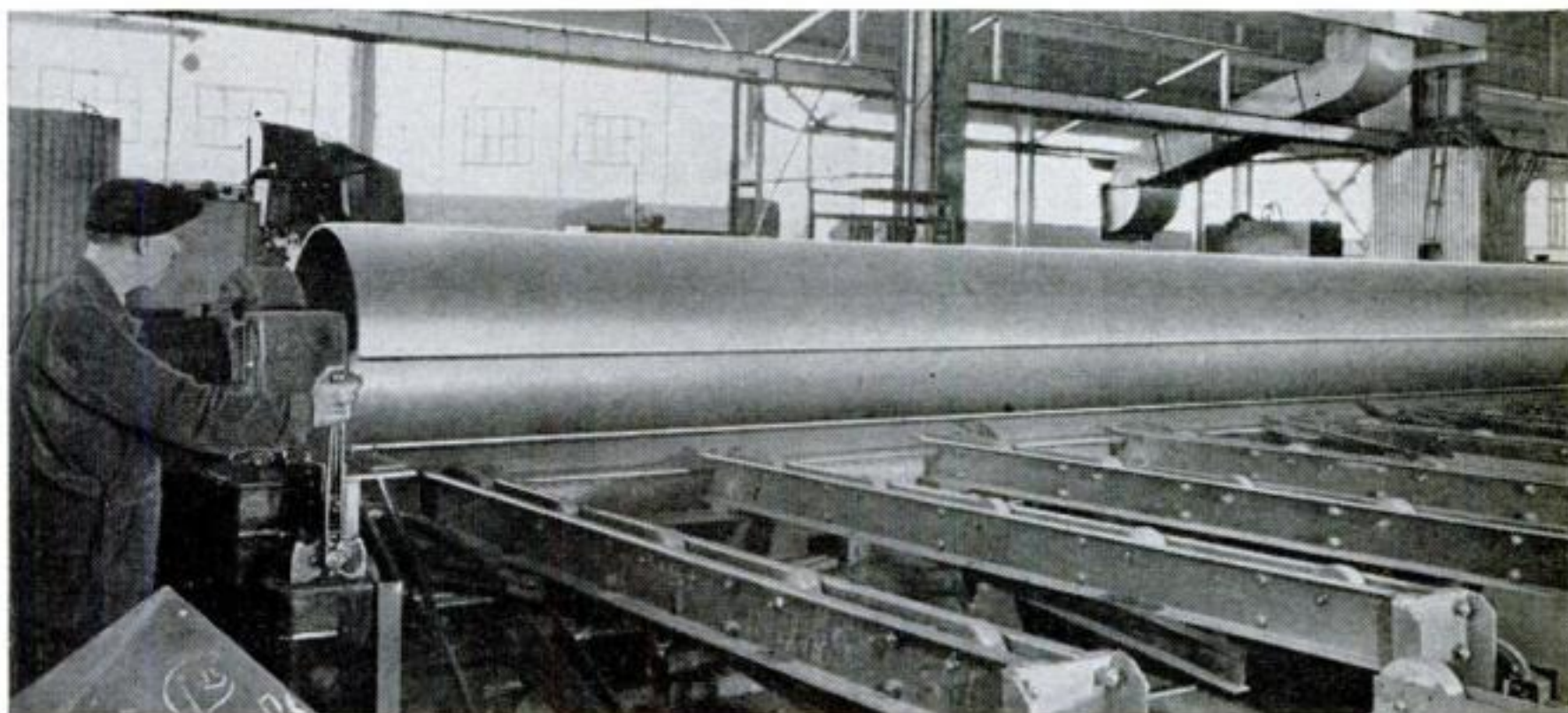
# Goes West

mand and slowly diminishing gas reserves.

The pipe starts at the big Hugoton-Panhandle basin and the Permian basin to the south. Hugoton alone is estimated to hold enough gas to feed the line 140 years. Processed to remove hydrogen sulfide, gas will be dehydrated to prevent pipe corrosion. Pressure, maintained by compressors, will reach 810 p.s.i. in final section.

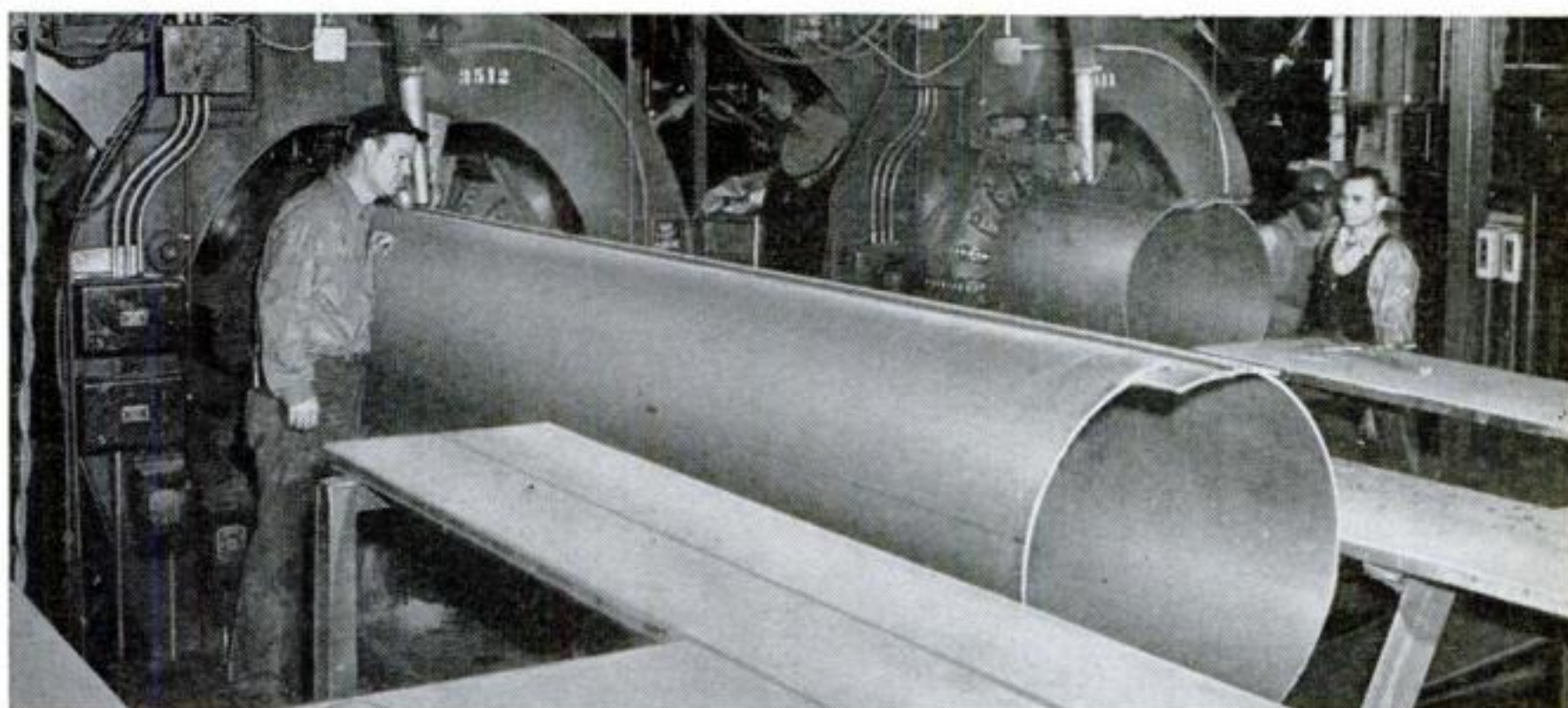


**Big mangle** irons out waves in special manganese steel plates for 30-inch pipe. Each sheet is about 92 inches wide, 30 feet long, only 9/32 inch thick.



**Plate is rolled** like a cigarette. Revolving steel cylinders grip and pull it through, bend it into cylinder and bring edges together for the seam.

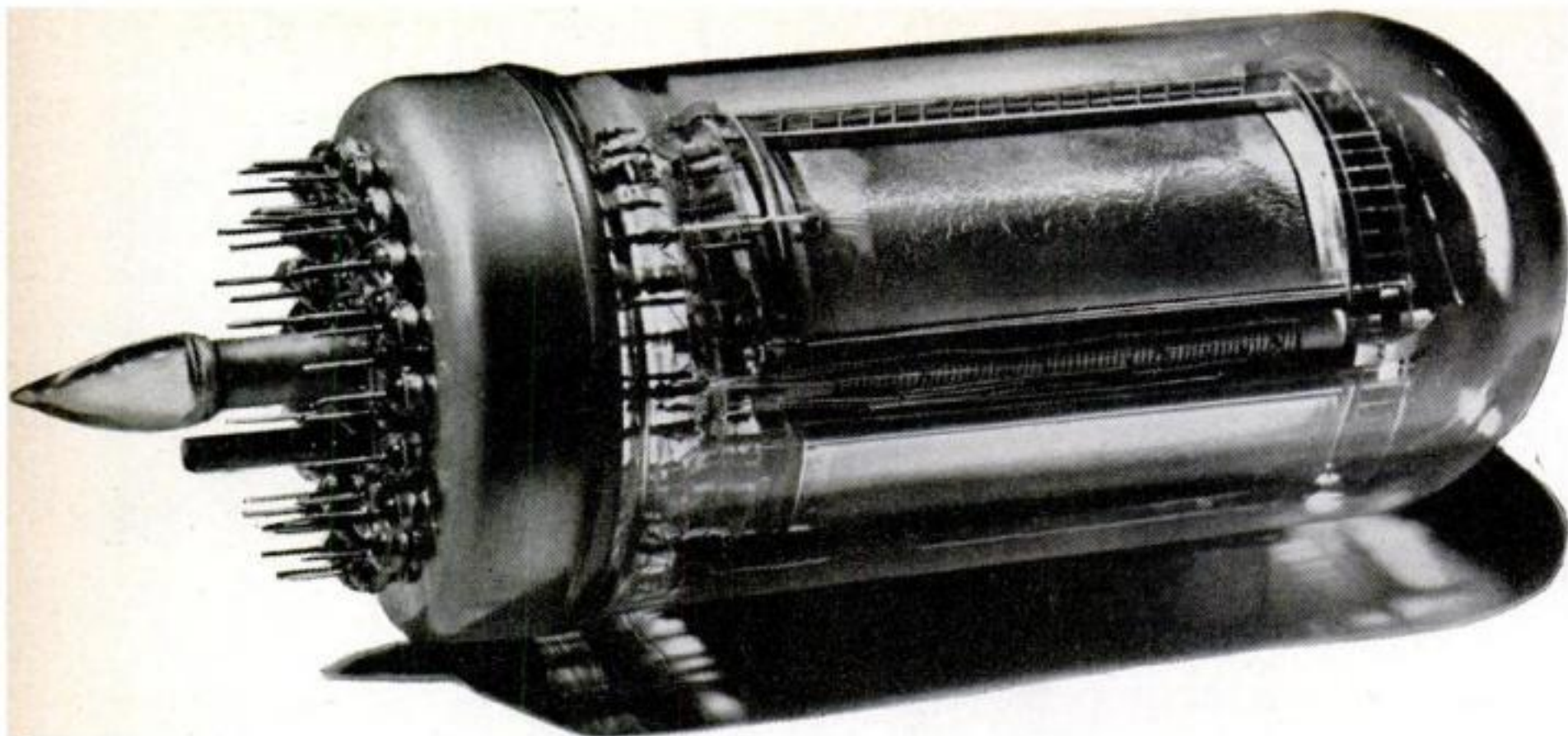
Thanks to pressure control in the line, pipes can be extra thin, saving 7,400 tons of steel. Section now moves to automatic submerged-arc welder.



**Seam is welded** by high-voltage current, carried to pipe through a granular melt laid down along the seam just ahead of the electrode, which is

immersed in it. All welding action takes place underneath the melt. The resulting weld penetrates the metal and is stronger than the parent plate.

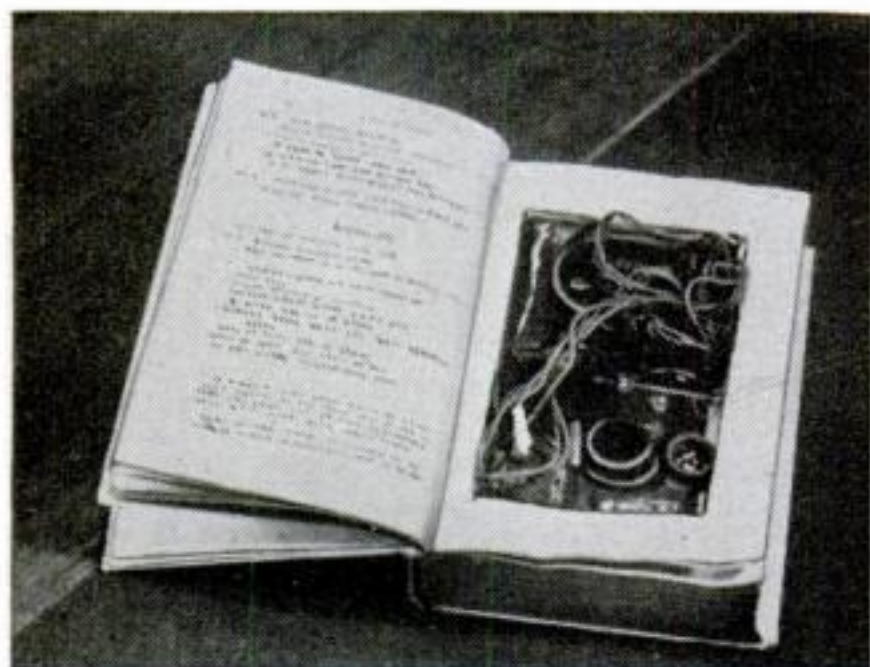




## Tube with a Memory

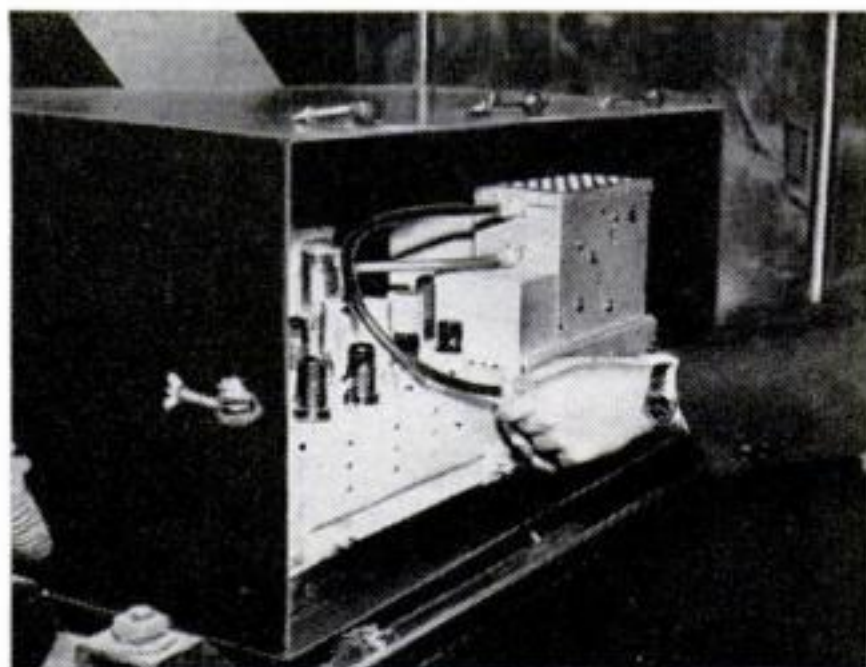
DEVELOPED to help electronic computers "remember" the factors involved in long mathematical sequences, RCA's Selectron is expected to permit the multiplication of two 13-digit numbers in about one hundred-millionth of a second. A screen of tiny wires

forms a checkerboard of windows through which electrons can pass to store electrostatic impulses, representing up to 4,096 mathematical factors, on a target insulator. The tube's circuit "opens" the windows individually to receive impulses and to release them again whenever they are required for the calculation.



## How Dutch Hid Radios

WHEN the Nazis confiscated Dutch radios in 1943 to restrict foreign broadcasts, pocket-size receivers by the thousand were secretly turned out for the resistance movement by workers of the Philips Research Laboratory, Eindhoven, Holland. The one shown in the cutout portion of a book is typical of their design. Using only one or two midget tubes, they were hidden in lamps, powder dusters and other everyday objects. One, inside a can of vegetables, was even sent safely into a Nazi prison camp.



## FM Aids Railroads

THIS mobile FM transmitter-receiver, part of equipment recently tested on the Southern Pacific Railroad, provides a stormproof party line for train crews and dispatchers (PSM, April '45, p. 130). In the tests, engineers in the cabs of long freight trains checked their orders with conductors riding in the cabooses, with stations along the line and with San Francisco headquarters via telephone relay. Use of the experimental equipment was reported to have saved time and trouble in handling trains.



# 6-in-1 Wind Tunnel

**NACA's compact, inexpensive, versatile research "package" is ready for U. S. colleges.**

A POOR man's wind tunnel, a 20th of the usual price, is now available to American colleges. Designed by the National Advisory Committee for Aeronautics, it comes as a "package," takes up a third the space of a baseball infield, and can be used for at least six major types of aviation research.

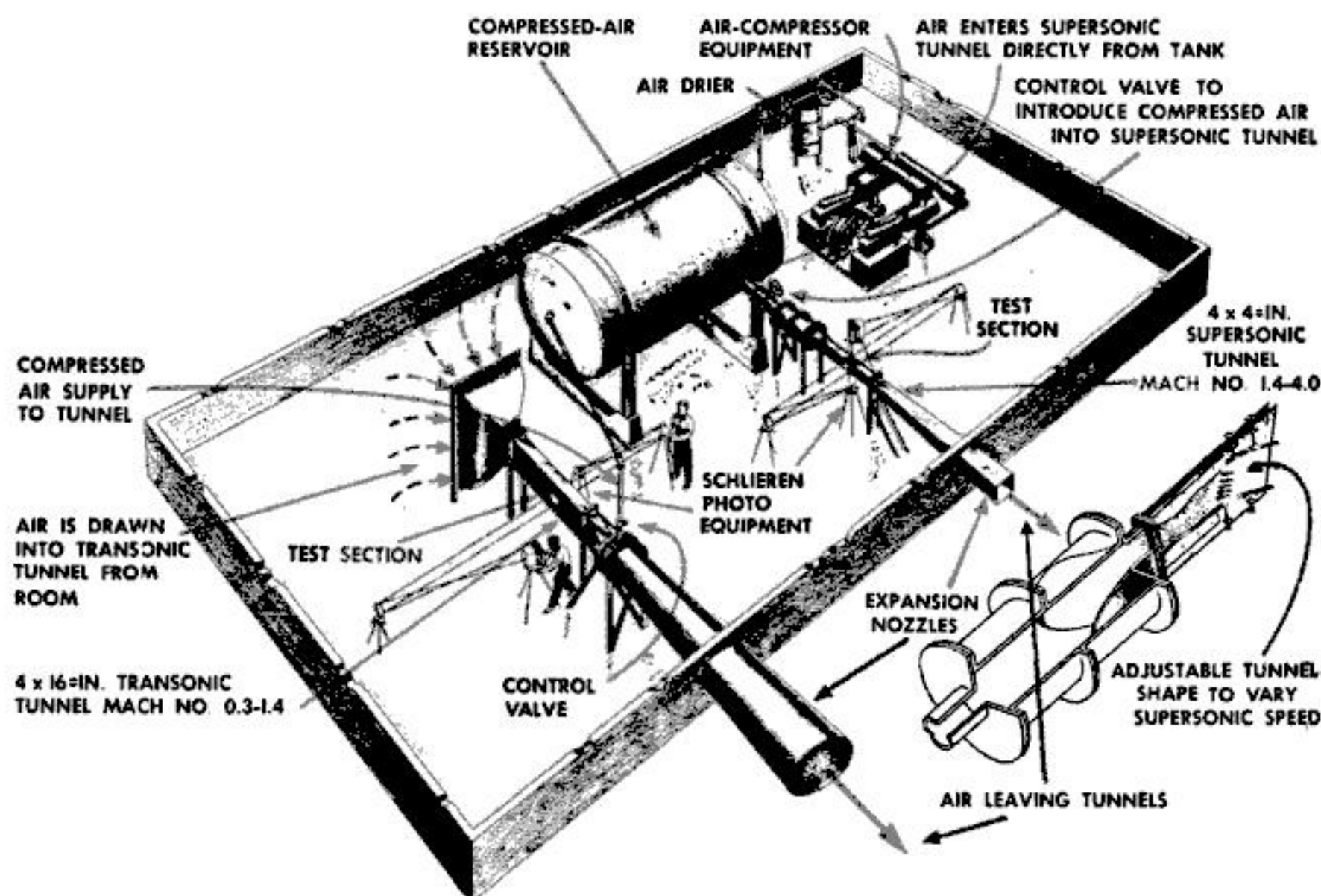
The Navy is making the new tunnel, called the Compressible Flow Unit, available to colleges on a share-the-cost basis. The entire installation, which can be comfortably housed in a one-story building 40 by 65 feet, costs only \$50,000 to \$75,000—or even less if surplus war materials are used. Present wind tunnels cover at least one acre, cost about \$1,000,000, and are expensive to operate.

Unlike the old "continuous" tunnels, which run under steady pressure, the packaged

tunnel is the "blow-down" type. Air is compressed in a tank, then released to provide the stream. The air flow lasts only a few minutes before the tank must be refilled, but in this time it can achieve a speed as high as any tunnel has reached—Mach No. 4, or more than 3,000 m.p.h.

The Navy expects the units to be used for studies of airfoils, combustion problems in ram-jets, and tests of nozzle shape effectiveness (useful for tail-pipe design). Other potential research subjects include the internal-flow problems found in jet units, the comparative value of various combinations of wing and fuselage shapes, and the heat-transfer problems resulting from friction on the outer skin of aircraft.

The tunnels promise the training of more students in aerodynamics to replenish the reservoir of young scientists emptied by wartime Selective Service (PSM, Mar. '46, p. 88). The first of the units is being tested at the NACA laboratory at Langley Field, Va., where it will be a showcase sample for prospective customers.



The Compressible Flow Unit has two small tunnels: a transonic tunnel with a 14- by 16-inch test section and a supersonic tunnel four inches square. Compressed-air system, with reservoir and dryer, powers both.



# This Is Where Your Money Goes

Small change is big business in vending machines that mix drinks, pop corn, insure your life—and keep out slugs.



**By Herbert Johansen**

*PSM photos by W. W. Morris*

**T**HE vending machines that now mix drinks, pop corn and sell you anything from hot coffee to insurance policies represent an investment of more than a thousand 10-ton trucks full of nickels. The maws of the coin-operated machines dispensing chewing gum, nuts, beverages and candy took in almost half a billion dollars last year. No one knows how many millions went through the mechanisms of their coin-in-the-slot brothers, but some retailers estimate that, by 1957, about three billion dollars worth of merchandise will be sold this way annually.

These figures do not take into consideration the astronomical take of other types of coin machines—pinball games, “one-armed bandits” and juke boxes. Such entertainment and gambling machines are a field apart; the National Automatic Merchandising Association will not accept as a member a manufacturer, distributor or operator who handles even one slot machine.

Minit-Pop, like many of the new vending machines, automatically performs several separate functions to prepare and dispense a fresh quantity of merchandise each time a coin is inserted.

Aside from the ubiquitous cigarette, candy, gum and nut machines, a coin or coins (from a nickel to a quarter) today will pop, butter and package a bag of popcorn for you; will mix you a drink of any of three selected flavors; shine your shoes; deliver an electronically heated sandwich or hot dog; record your voice or take your picture; sell you ice cream, milk or hot coffee (black or with cream, with or without sugar); sell you a newspaper; write trip insurance or sell you a railroad ticket; give you the use of a typewriter, radio or television set; fill your lighter, or do your laundry. This is but a gleaning of what coin vendors have to offer. Of course, there are always the coin telephone, the subway turnstile, lockers and washrooms, and other coin-operated service devices.

There are two types of automatic vending machines: the mechanical, in which the coin becomes an integral part of the machine, enabling it either to drop or eject the product;





As coin starts motor, a cup of raw corn moves toward popping basket, the lid of which opens to receive it. The oscillating basket has a perforated bottom and rests in a reservoir of seasoned oil.

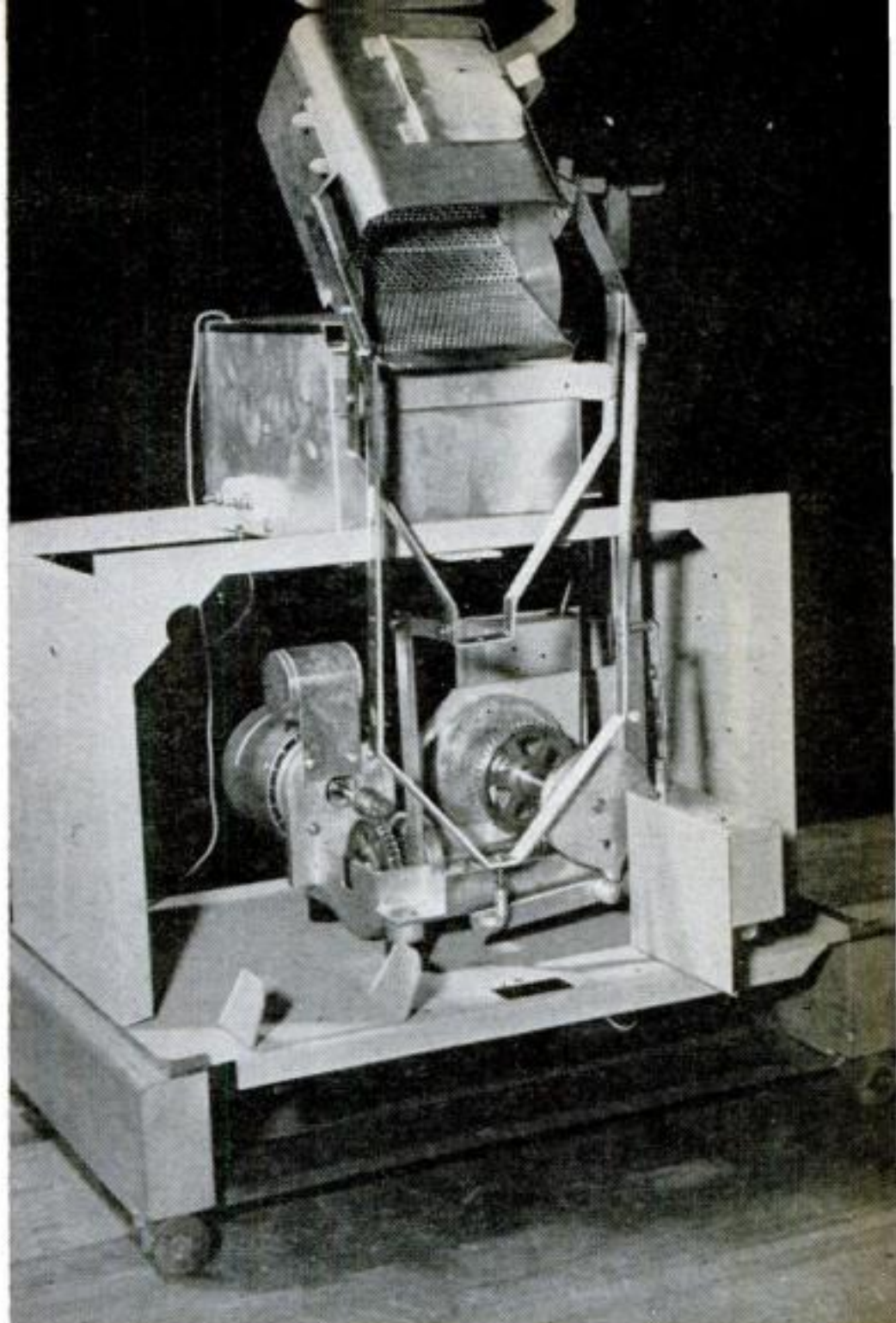


After 60 seconds of popping, the basket is lifted to the position shown above, causing its door to open and cascading the finished popcorn into the bag. Present models have external salt dispensers.

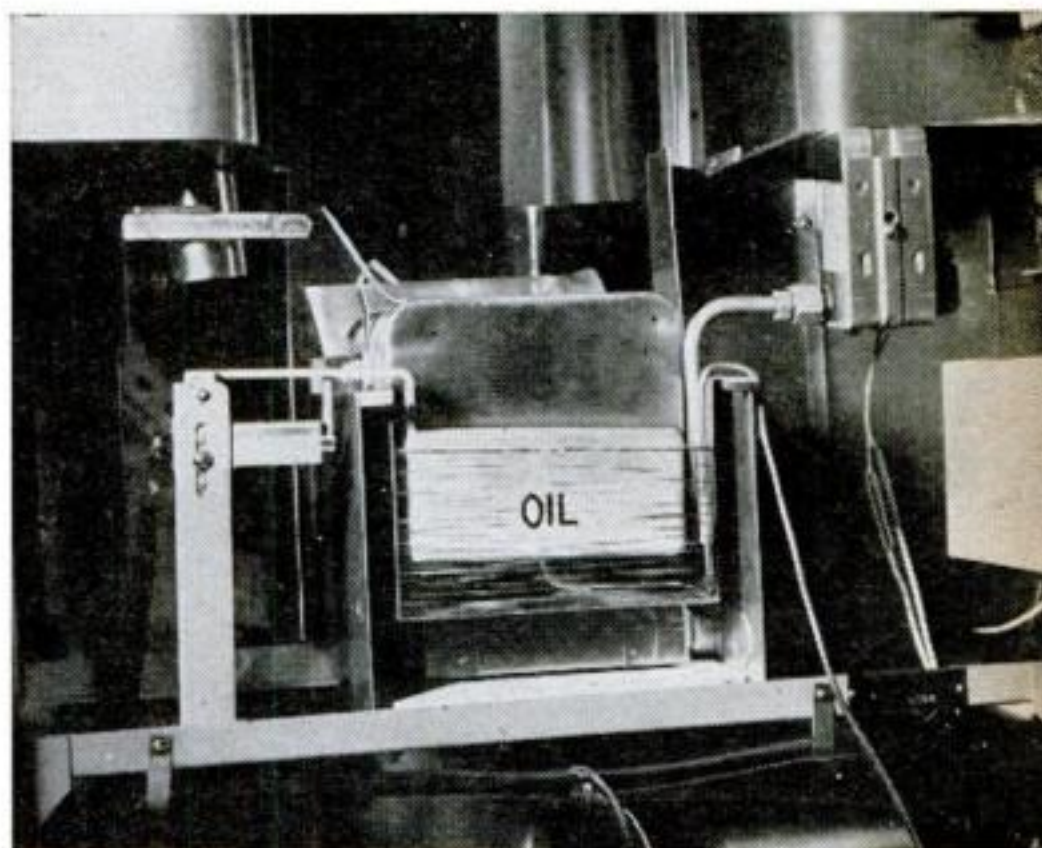
and the electrical, in which the coin closes an electric circuit that starts one or more mechanical and electrical operations.

The heart of practically all vending machines is a mechanism that weeds out counterfeit and foreign coins and slugs. Even with this slug rejector, however, in an unlucky year vending-machine operators have lost some \$5,000,000, not counting the pennies withheld by those who blew down the chutes of weighing machines to get a free weigh.

In a typical slug rejector, each coin is first checked for proper diameter and thickness. Badly nicked, warped or perforated coins are rejected. Next the coin passes through a magnetic field that rejects coins not containing the proper metal alloy. The coin rolls down inclined rails past the magnets, which tend to retard its travel. The type of metal or alloy in a coin determines the speed at which it leaves the inclined rails. If it is traveling

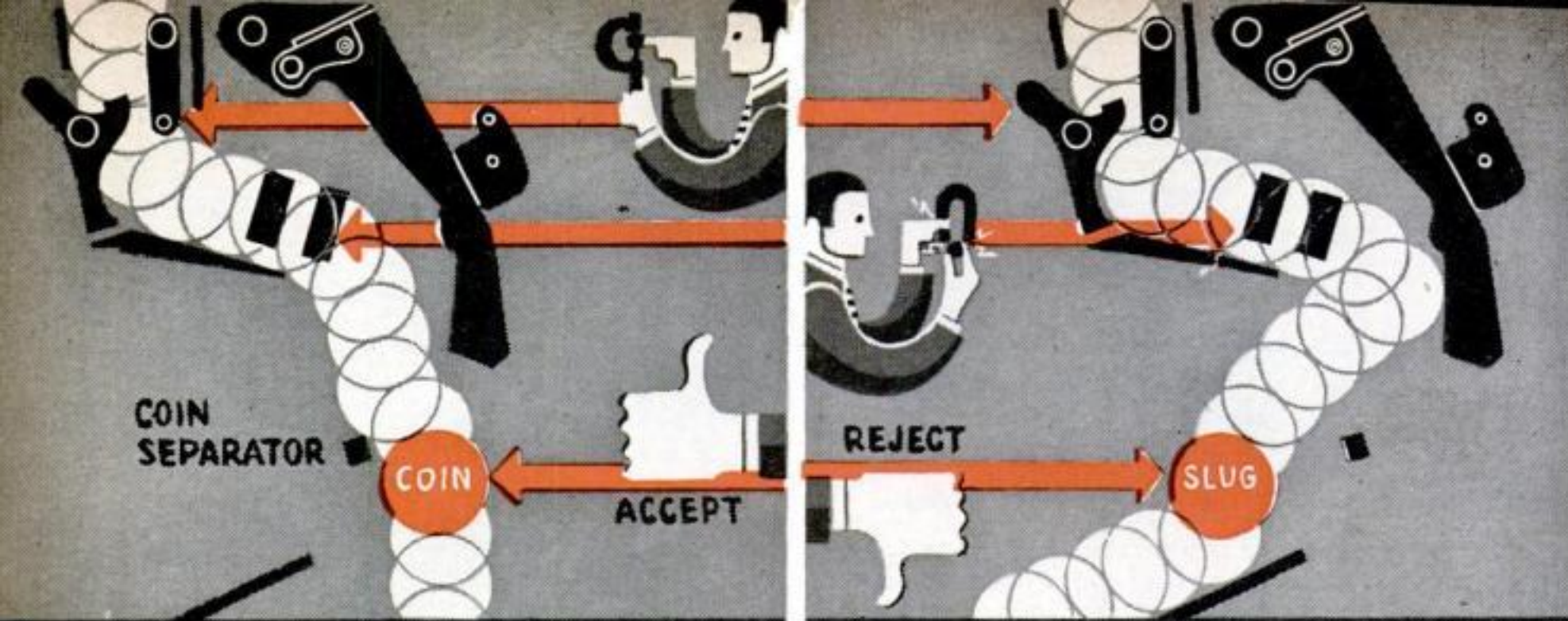


Lower part of the machine holds the constant-speed motor (left) that drives gear and cam assembly (right), controlling mechanical functions. A timing device prevents operation when temperature is low.



Basket rests  $\frac{1}{4}$ -inch deep in oil reservoir, which is kept at constant level. Float gauge connected with time switch (left) electrically controls valve of oil tank (right) to permit necessary gravity flow.





**COIN ACCEPTED.** Diagrammatic drawings of a typical slug rejector show how it tells the good from the bad. A coin first passes the test for size, then rolls down rails past magnets that test the alloy. When it is made of the proper alloy, the coin travels past the magnets at a speed that causes it to fall with its center of gravity to the right of the separator. This lands it in the accept channel and puts the machine in operation.

**SLUG REJECTED.** A slug of the wrong size would be caught at the start of the path. This one gets by, but the magnets spot it. A poorer conductor than a real coin, its magnetic response is less and it travels faster. It bounces off bottom of wiper blade, falls to the left of the separator and goes into the reject channel. A more conductive alloy would have been retarded by the magnets, fallen almost straight down, and met the same fate.

too fast or slow, the coin strikes reflectors or barriers and is deflected into the reject outlet.

The weight of the coin, its hardness and its elasticity are also tested; if not up to par, it falls short of or beyond the "accept" path.

Most unacceptable coins or slugs are immediately channeled to reject outlets. Slugs trapped because of wrong size or held by the magnets, however, are released by a wiping mechanism that sends them to the reject outlet.

### *One that Will Work*

There is a slug of a certain alloy that will be accepted 100 percent by even the most sensitive slug rejector, but the less said about that the better. As a metallurgist who is now in the automatic vending machine business said, "I can make phony dimes that any machine will take, but they would cost about 20 cents apiece." Slugs for the penny and nickel slots are the easiest to make; as dimes and quarters are tested for silver content, the counterfeiter's task is made more difficult and hardly worthwhile.

Perhaps the most effective slug deterrent, however, is a law that makes it a Federal offense, punishable by a \$5,000 fine or two years in jail, or both, to manufacture or use slugs.

The mechanical slug rejector sends a genuine coin on its way to release an item of merchandise. But that wasn't enough for Charles F. Harris, executive of a southern

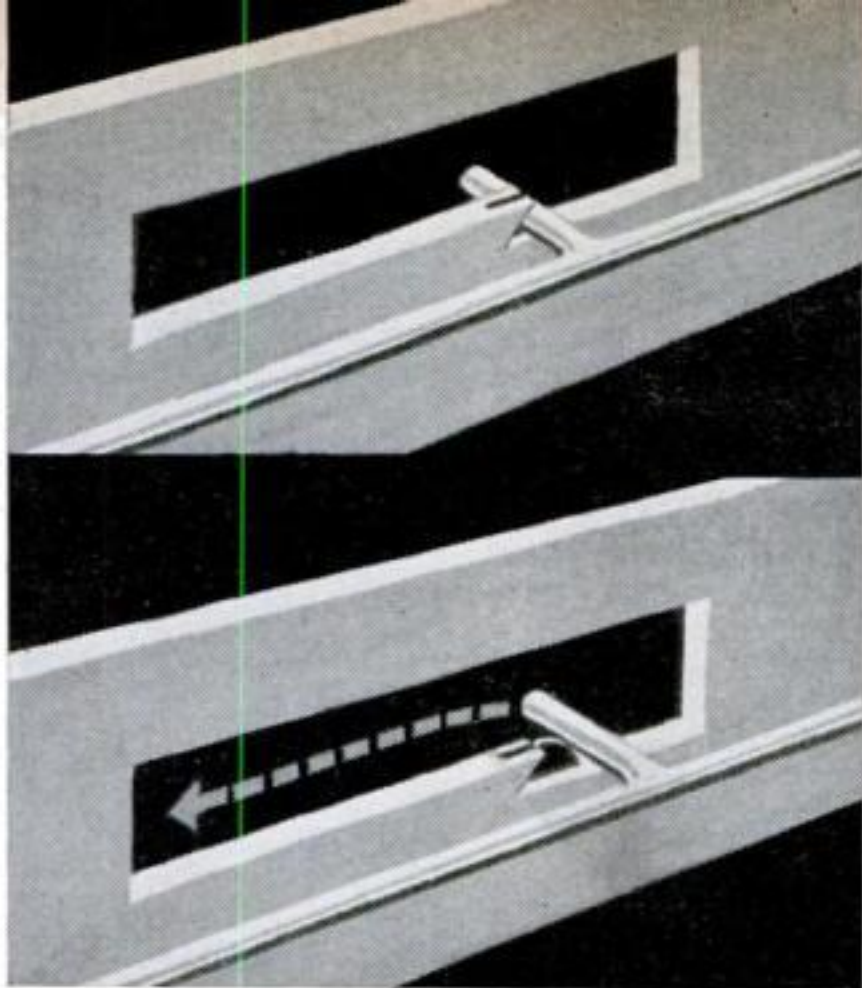
railroad, who got thirsty while attending a murder trial one sultry day some years ago. He stepped into the corridor where there was a cold-drink vending machine, but he didn't have a nickel. As he wanted that drink badly, he had to go to a store several blocks away. When he returned to the courtroom his thirst was quenched, but someone had taken his seat.

Annoyed by this inability of the dispensing machine to make change, he got to work. Fifty-six models and several years later he came up with a mechanical unit that enables a vending machine to take a dime or quarter, sell a nickel product and return the proper change. Now the Harris Coin Changer, made by the Johnson Fare Box Company, is on the market, improved and adaptable to all types of automatic vending machines. One of many coin changers now on the market, it incorporates a feature that prevents it from "jackpotting," or returning a hatful of nickels in change for a quarter. (There are those who say that this feature has always been standard equipment on the one-armed bandits.)

Another type of coin changer, the Vendo, is not a part of a vending machine, but a separate unit offered as a service at locations where there are a number of coin-operated vending machines. All coin changers obviously incorporate a slug rejector.

Although there are hundreds of different types of vending machines on the market,





The upper drawing shows how, without a coin, the operating pin of the mechanical type of vending machine is caught in a notch, freezing the mechanism. When a coin is inserted, as shown in bottom picture, it lets the pin ride over the obstruction.

the basic operating principles are comparatively few. The simplest is the kind in which the coin or coins start an electric timer that permits the use of some standard piece of equipment, such as a radio, an electric washing machine, or a typewriter, for a predetermined period of time.

In the familiar multiple-choice mechanical cigarette and candy vendors, the coin, as mentioned before, becomes an integral part of the machine's mechanism. Without a coin, the operating rod of the machine is caught in a notch when the selecting plunger or handle is operated. When a coin is inserted it falls into a slot that allows the pin of the operating rod to ride over the notch, activating a mechanism at the back of the machine that releases or ejects the selected item.

In one version of this type of machine, the activating mechanism releases a trapdoor that drops the product down a chute into the delivery opening. In another, the products are placed in shelves that form an endless chain. To make his selection, the purchaser turns a knob that brings the desired item into a position usually indicated by an arrow. The coin is inserted and the pushing of a plunger, pulling of a handle or twisting of a knob results in the bar of candy or package of cigarettes being ejected from the machine.

This endless-chain type, because it holds a selection of 50 to 150 titles, is being adapted for the sale of Pocket Books for a quarter-in-the-slot.



A typical mechanical vendor. At left is the slug rejector. Genuine coins act as part of the machine, so that the turn of a knob operates a plunger, which in turn activates mechanism at the rear to release or eject product into dispensing compartment.

In electrically operated vending machines, the coin closes an electric circuit that starts one or more operations, either ejecting or releasing a packaged product or actually preparing a product—mixing a cold drink, heating a hot dog or popping corn.

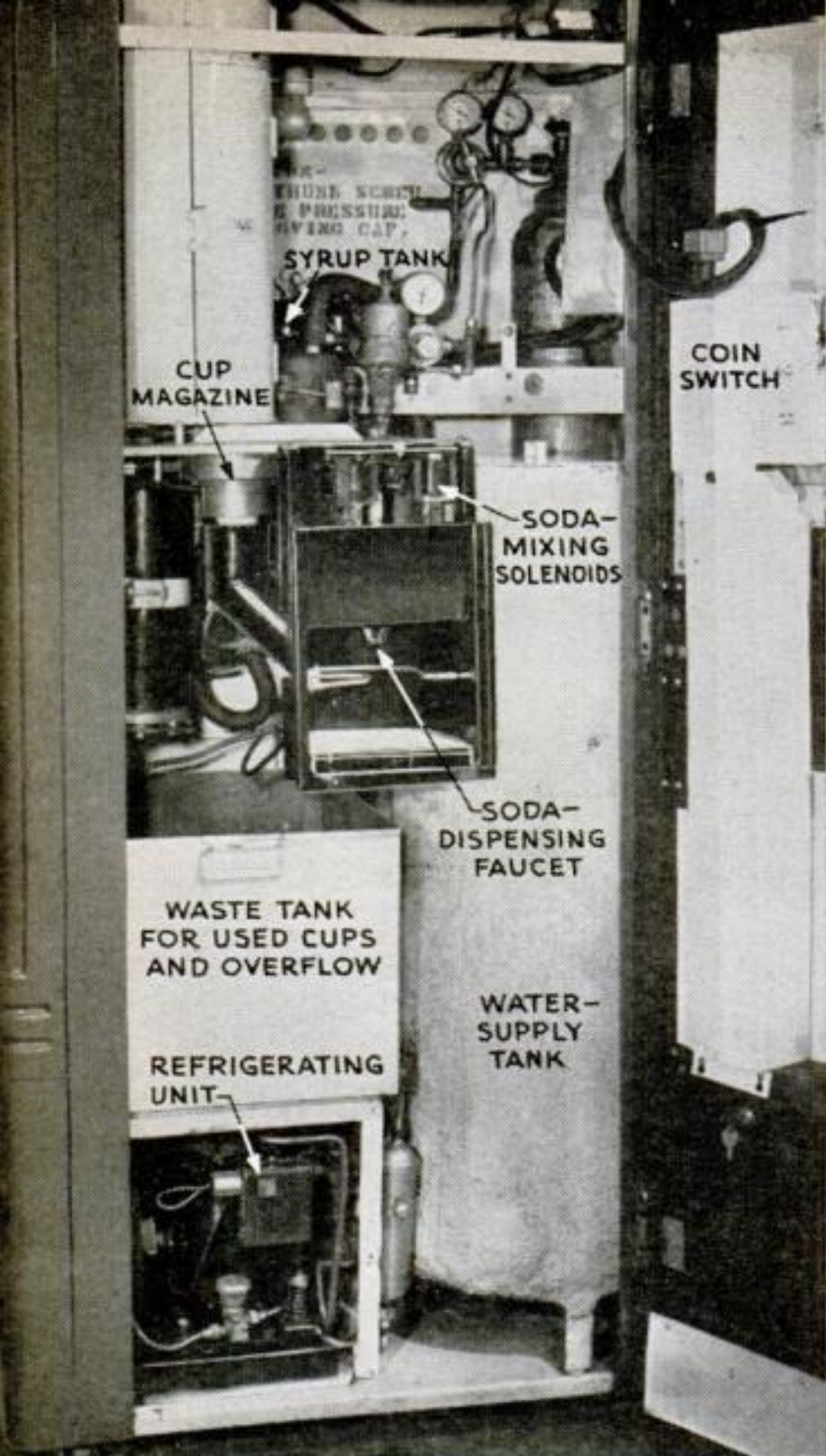
The Minit-Pop, manufactured by the Viking Tool and Machine Corporation, of Belleville, N. J., is a good example of the new types of coin-operated machines coming on the market. In return for a dime, this machine takes raw corn, pops it in front of your eyes, and delivers the hot, freshly popped product in a glassine-lined bag.

#### *Hunting for an Oil*

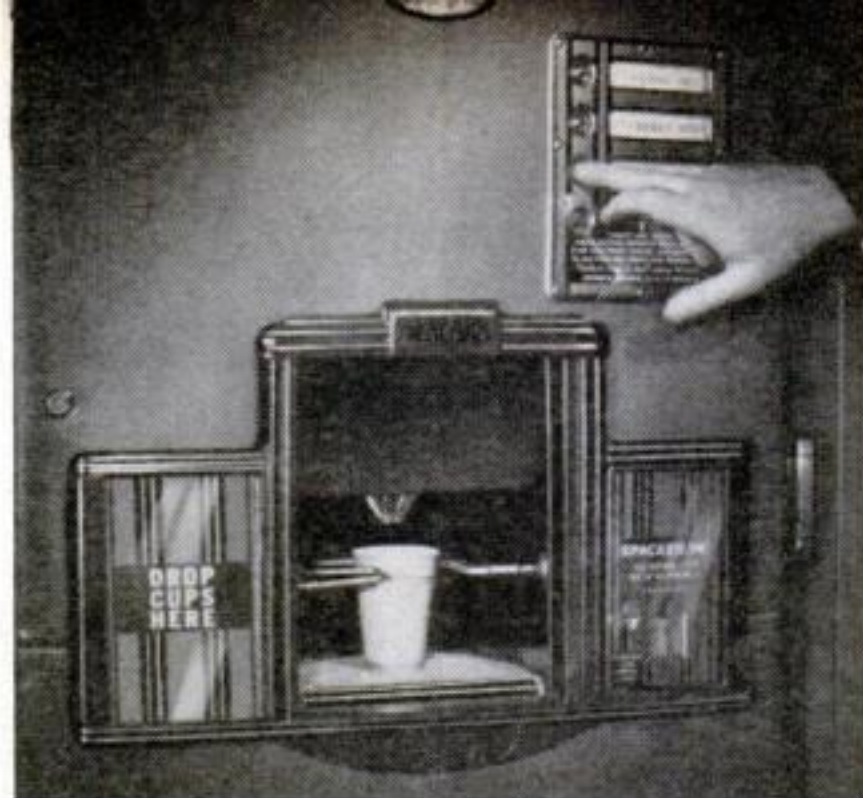
Perfecting of the Minit-Pop involved the manufacturer in a variety of research problems. Scores of edible oils were tested before a variety of peanut oil was found that would taste like butter and still not become rancid. It was found that popcorn has a critical "popping" temperature of 410°. A deodorizer had to be devised. Although a well-known fact to the National Association of Popcorn Manufacturers, the Viking people were amazed to learn that unlike ordinary table salt, which has only 6,000,000 grains to the pound, popcorn salt has 60,000,000 grains, the better to sift through a bag of popcorn and into the crevices of every kernel.

Another new electrically operated machine, although not strictly a merchandiser,





Front interior view of the Spacarb, one type of the coin-operated soda-dispensing machines now on the market. Enclosed unit on door at right contains the slug rejector. The carbonating unit produces a continual supply of fresh soda water. Improved versions of the automatic soda fountain are on the way.



New soda vendors feature an ice-cold drink in any one of three flavors. Coin starts operation and drops the paper cup into place. Those quick on the button can snatch a dash of a second flavor.

cess depends on pleasing the public and offering machines that will operate under trying conditions. The C-8 Corporation, of Newark, New Jersey, for instance, runs continuous tests on the parts of their new electrically operated cigarette machine. When the tooth of an alloy ratchet wheel broke after 70,000 revolutions, the equivalent of five years of normal operation, it was immediately replaced by a sturdier steel wheel.

This Electro cigarette machine has several new features. Since it is activated by slight pressure on a selector button, it escapes the wear and tear of the mechanical type, which seems to inspire the customer to test his strength in pulling the selecting handle or plunger. Also, its electric coin counter is so rigged that one machine can sell products of three different prices.

#### *By the Back Door*

Refrigeration came to the vending machine industry via the back door in 1927. At that time a group of financiers invested \$1,000,000 in the patent rights of a quarter-operated picture-taking machine. It worked fine, except that there was no way of maintaining the developing chemicals at a necessary temperature of 65°. To protect their investment, the backers financed the development of a refrigerating unit and a cooling tank. This in turn led to the introduction of a number of machines selling chilled drinks, and later to ice cream and milk vendors. As yet there are no automatic coin-operated vendors of frozen foods on the market. Freez-O-Mat, however, has a nonautomatic model that can easily be redesigned for

'is the Insurograph. Now in use at several air-line terminals, it sells air-trip insurance at a quarter for each \$5,000 policy. The coin starts a series of operations that begins with the stamping of the date, hour and minute, plus a facsimile signature of the insurance agent. Next a slide uncovers a blank policy that the applicant fills in, after which he presses a button that delivers the policy to a receptacle at the front of the machine. A duplicate policy is retained in the machine to be collected later and sent to the insurance company.

The thoroughness with which the new vending machines are engineered and tested indicates the industry's realization that suc-





Selling trip insurance at 25 cents per \$5,000 policy by automatic coin machines has proved so successful at several air-line terminals that the service may be extended to railway stations and bus depots.

automatic operation. It is only a matter of time before both perishable and nonperishable foods are sold the coin-operated automatic way.

Although not yet on the market, Gasotera's entry in the field of automatic merchandising will be good news for motorists, who know that gas tanks have a habit of running dry late at night or at other times when filling stations are closed.

#### *Buying on Credit*

This new device is simply a coin-control unit that will interlock with the regular gas pump mechanism for automatic operation when the station is unattended. When coins are inserted (nickels, dimes and quarters), a credit is set up for the amount put in, and the pump is automatically set for the withdrawal of the equivalent value in gasoline. If the motorist overestimates, a "nonspill" nozzle will keep the tank from overflowing, and change will be returned for the amount of gasoline not taken.

Despite the fact that shortages of materials and some products are holding up many new developments, the automatic vending industry is optimistic about the future. It can also look back to quite a past. More than 2,000 years ago, Hero of Alexandria, considering the convenience of temple visitors, invented a mechanical vending machine—a vessel that took a five-drachma coin in the slot and spouted a measured quantity of sacrificial water. But not until the slug rejector was developed to overcome human nature did vending machines become big business.

END



The Book-O-Mat, with its two endless-chain conveyors, holds up to 150 25-cent books, and a customer can choose any one of the different titles. One-third of the machine's contents is always visible.



Hero of Alexandria invented this vendor some 2,000 years ago. A coin dropped in the slot hits a spoonlike plate, depressing it and opening valve. When coin slips off, flow of sacrificial water stops.



## AIDS TO MODERN LIVING



**FLEXIBLE PLASTIC BOWLS.** Kitchen bowls made of plastic by Tupper Plastics, Inc., of Farnumsville, Mass., bend easily, making it possible to pour liquids from them as you would from a pitcher without need of a funnel. The bowls are cleaned by flexing to loosen dried-on food, and then washed in warm water. They are sold in nests of three sizes—5½", 6¼", and 7".

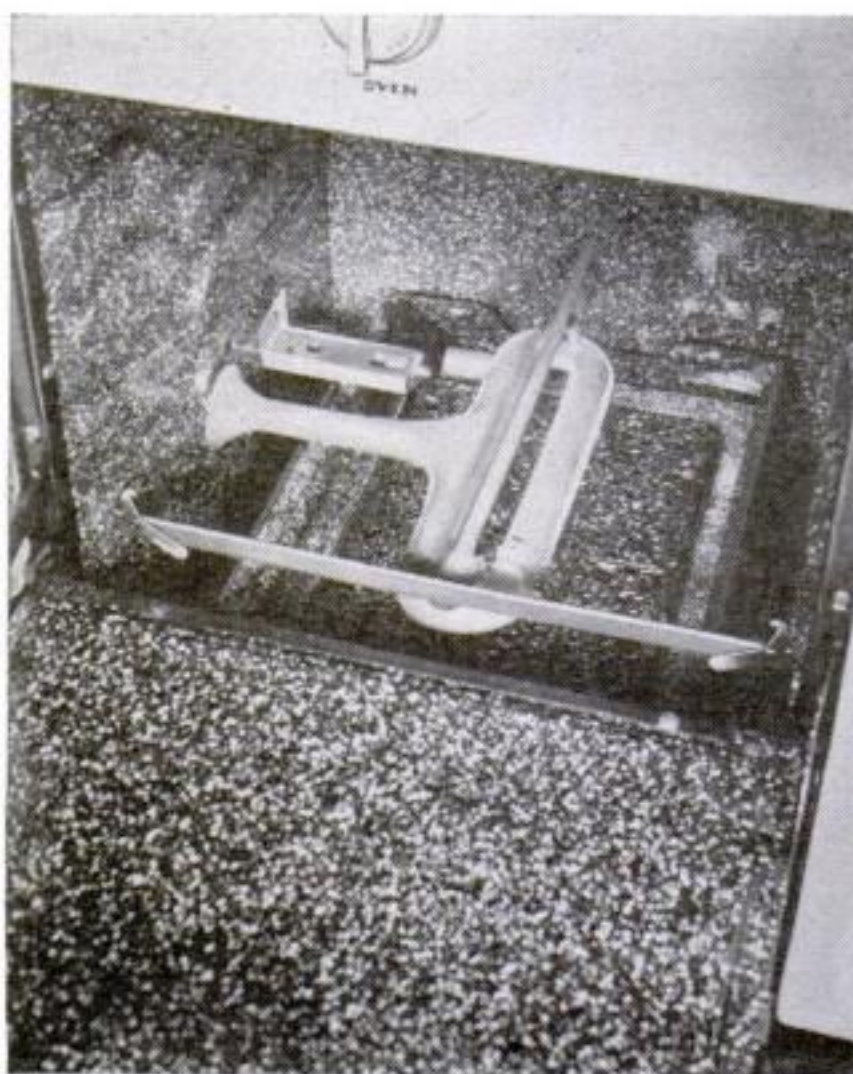


**AUTOMATIC RANGE LIGHTER.** Eliminating the need for stooping with a lighted match, a new lighter on many gas ranges now being made provides automatic ignition for the oven and broiler burners when the valve controlling the flow of gas to them is turned on. The lighter has been tested and certified by the American Gas Association. It is adaptable to three kinds of modern oven and broiler ignition—flash tube, gas pilot, and electric hot wire.

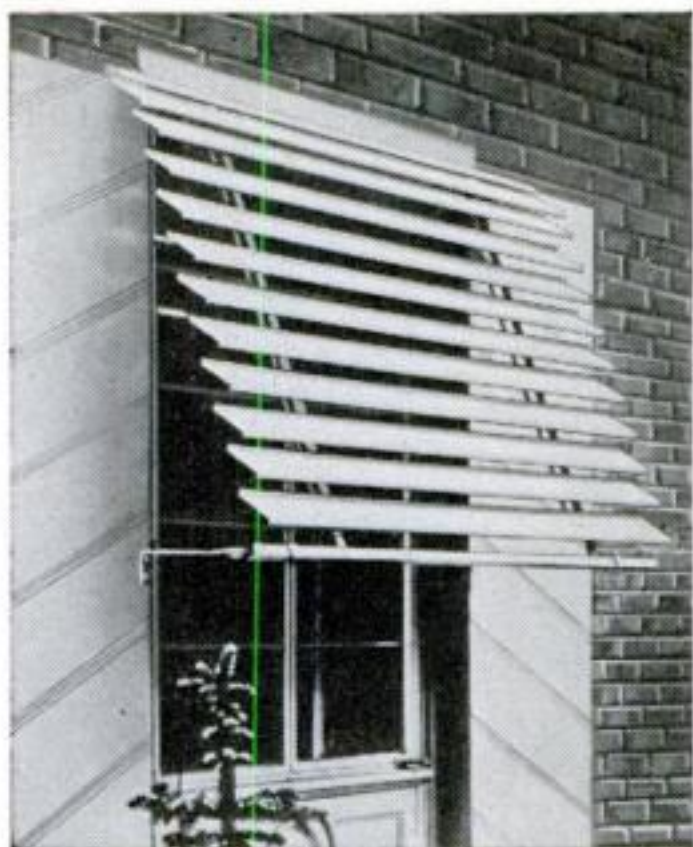
The association reports that gas-range users will find cycling flash-tube ignition advantageous since this type does not require an extra constant-burning pilot or an electric current to control the flow of gas. All the lighters provide safety, turning off the gas automatically if either the burner or the pilot goes out. The valve opens and shuts every time the oven or broiler is operated, constant use keeping it from sticking, and gas can flow only when there is a flame to ignite it the moment it is turned on.



**FISHERMAN'S FLY BOX.** A plastic fly box with a number of separate compartments is produced by the Tru Art Fly Co., of Gardner, Mass., to enable the fisherman to keep flies readily accessible and untangled even if the box is upset or carried on end. A transparent lid permits the contents to be seen at a glance. Separate compartments for leaders and line dressing eliminate any need for carrying extra boxes.

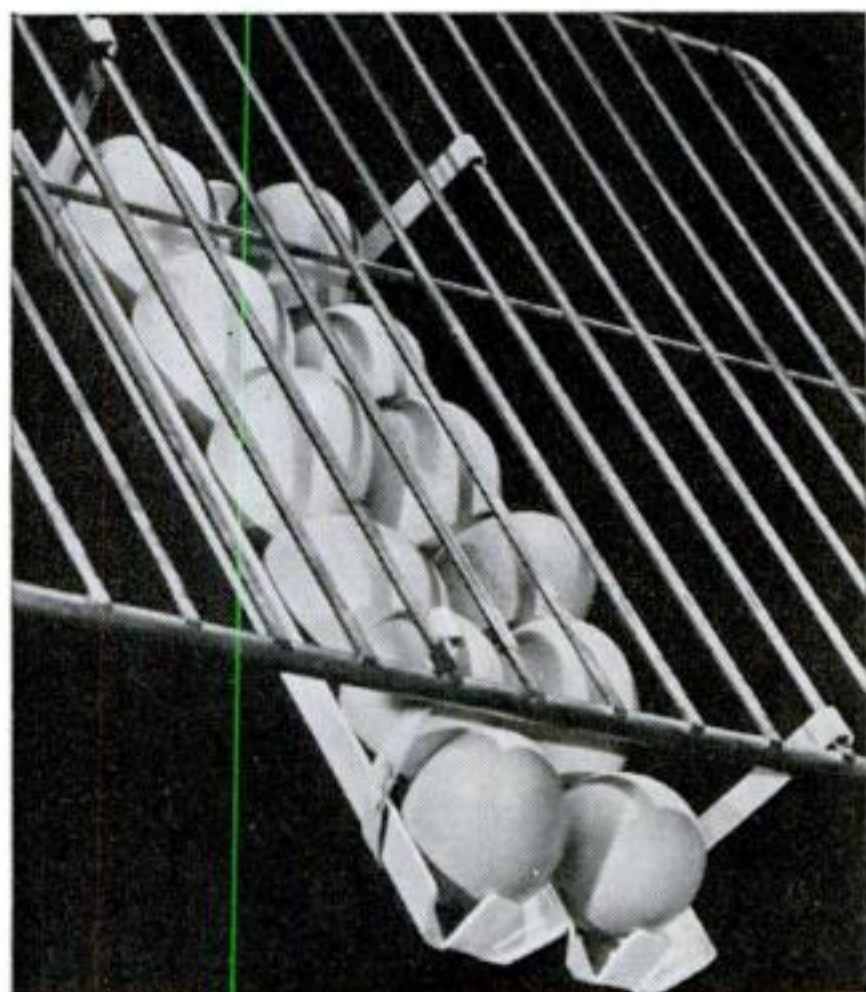






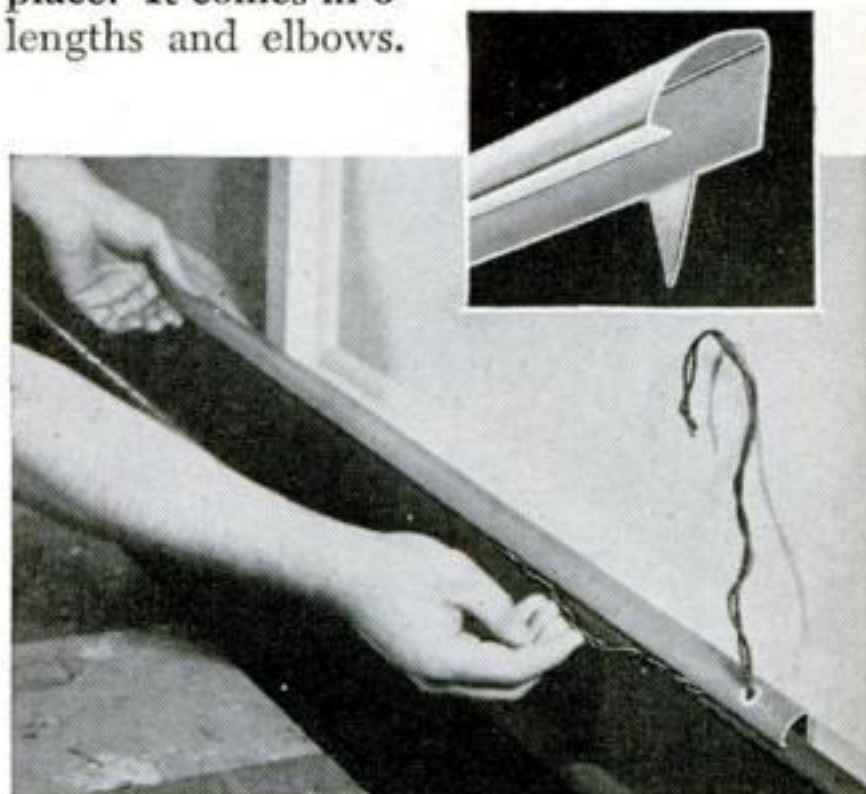
**VENETIAN-BLIND AWNING.** Features of both an awning and a Venetian blind are combined in a metal awning made by the F. C. Russell Co., of Cleveland. Operated by a crank inside the room, the blind can be adjusted to permit full ventilation and light or closed for a fully opaque awning. Baked-on enamel makes it rustproof.

**ADJUSTABLE TELEVISION SCREEN.** A television set with a screen that can be swiveled from side to side or up and down to suit viewing conditions has been designed by Sylvania Electric Products, Inc. The set is built around the 10" cathode-ray receiving tubes manufactured by the company.



**SLIDING EGG TRAY.** Hooked under a shelf, an egg tray made by the Davies Tool Engineering Co., of Camden, N. J., utilizes waste refrigerator space. The tray holds 14 eggs and slides forward for accessibility.

**HOLLOW STEEL MOLDING.** Used in place of ordinary quarter-round wood strip, a quarter-round steel molding produced by the National Electric Products Corporation, of Pittsburgh, serves both as a decorative trim and a raceway for telephone, buzzer, intercommunicator, and other low-potential wiring. Prongs spaced at 3" intervals are pushed behind or under the baseboard to keep the molding in place. It comes in 6' lengths and elbows.





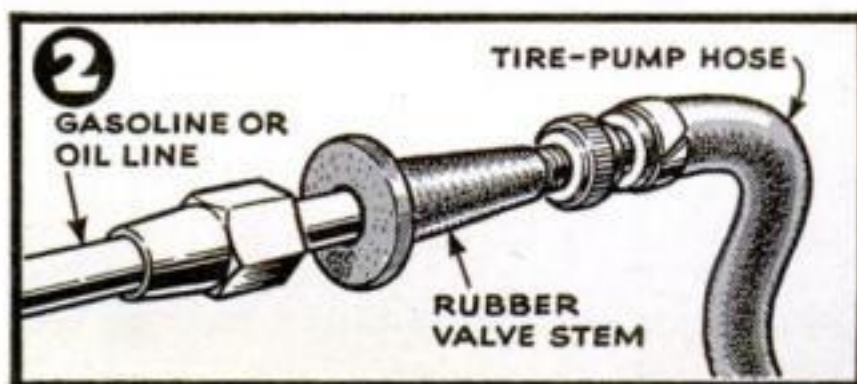
## AUTO HINTS



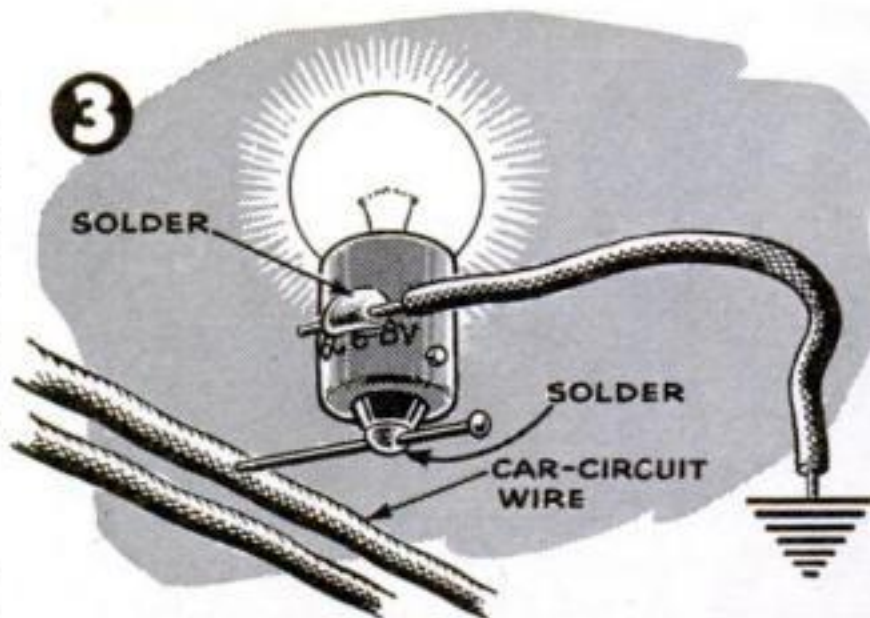
**1 FLUORESCENT CHECKS SPARK.** If you touch the end of a fluorescent lamp to a spark plug, it will flash in time with the firing, and irregularities can be detected more easily than by screwdriver shorting. A lamp with a burned-out filament will work as well as a good one. Hold the tube by the glass.—LEONARD L. ALLEN.



**2 PUMP CLEANS FUEL LINE.** A gasoline or oil line may be blown out with a tire pump and a rubber valve stem cut from an old inner tube. Forced over the end of the line, the stem makes a handy hose coupling for a hand pump.—W. H. LOWRY.

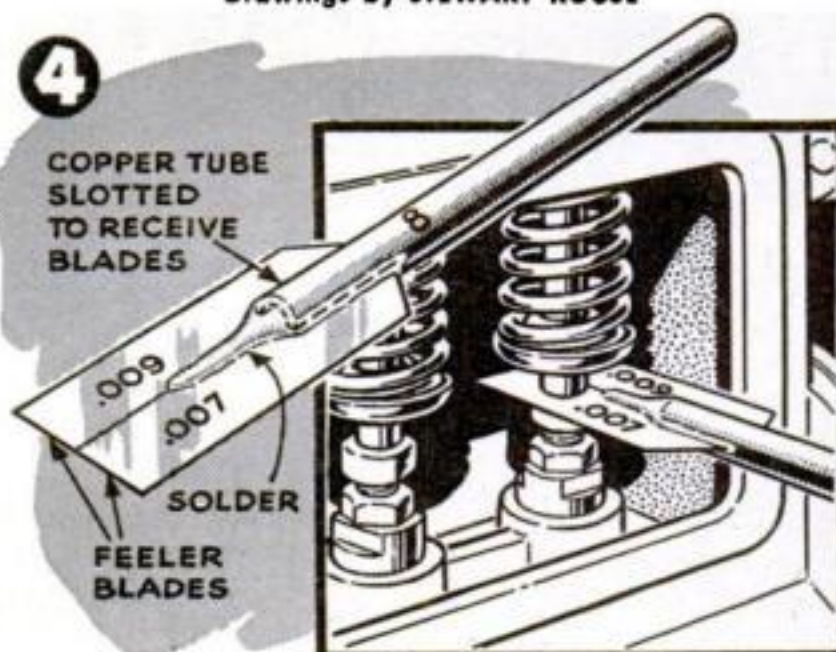


**3 PIN LOCATES WIRE.** Faced with the problem of finding the leads of my high and low-beam headlights in a maze of discolored wires, I turned on the high-beam lights first and used this device, sticking the pin into one wire after another until the bulb lighted.—SAMUEL LANDOW.

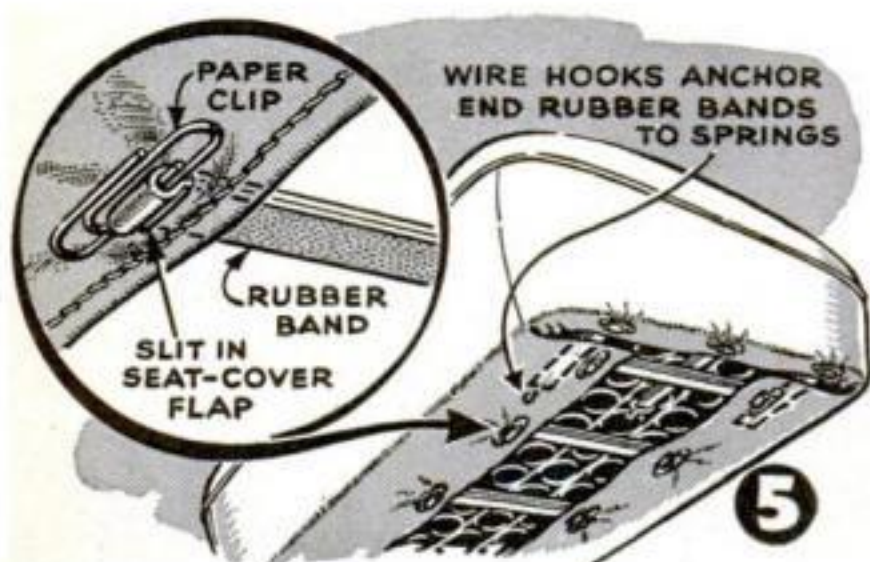


Drawings by STEWART ROUSE

**4 GAUGE ADJUSTS VALVES.** A "go-no-go" feeler gauge makes it simple to adjust valves accurately. Intended for a clearance of .008", this particular gauge was made from feeler stock (available at auto supply houses) of .007" and .009". Adjustments are made until the .007" blade passes freely between the valve and tappet, but the .009" one will not go.—D. W. BRENTLINGER.



**5 SEAT COVERS KEPT SMOOTH.** Inner-tube rubber bands attached to a seat cover in this manner will apply constant tension and prevent wrinkles.—H. G. WEBER.







**By Martin Bunn**

MEL MOWBRAY'S voice, as it came over the wire into Gus Wilson's Model Garage, was one of desperation and gloom.

"I'm in trouble, Gus," Mel said. "My crop of tomatoes has to get to the cannery by morning, and my truck has broken down."

"What's wrong with it, Mel?" Gus asked with real concern. Mowbray operates a small farm some 20 miles from our town, and he and Gus are old friends.

"I started to move the tomatoes out of the field this afternoon," Mel told him, "and on the third load something happened to the truck. All of a sudden it started to vibrate so bad it nearly shook me off the seat."

"Any idea what caused it?" Gus urged.

"Sounds like the bearing's gone on the end of that shaft that sticks into the fly-wheel," Mel answered. "I'm afraid to drive for fear I'll ruin the truck. But I've got to move those tomatoes before morning, and I can't hire or borrow another truck—they're all tied up this time of year. I know it's a long way, Gus, but can you come out?"

"It doesn't matter about the distance," Gus put in gently. "But you know how I feel about cutting in on another shop's business. You've always had your work done at Elmer Peters' garage out your way. Hadn't you better get him on this job?"

Mel's voice sharpened. "Elmer finished a complete overhaul of my truck just a couple of days ago, and he charged me plenty for it. Whatever's the matter with it now must be his fault. I'm through with that know-it-all.

# GUS Short-Cuts a Long Job

If you can't come out tonight, I'll tow the truck in to your place."

Gus glanced at the office clock. It was a few minutes to quitting time.

"I'll be along about half past six," he promised his farmer friend.

"We'll wait supper for you," Mel said.

Three quarters of an hour later Gus came to the crossroad that led to Mel's farm, steered his smooth-running old coupe off the highway's traffic-cluttered concrete, and for the first time in a couple of months heard the crunch of gravel under his tire treads. Wild flowers bloomed on the grassy banks that bordered the narrow road, birds sang, and somewhere back in the field a quail briskly reiterated, "Bobwhite, bobwhite, bob . . . white!"

Gus squinted into the glare of the low-swinging sun. "Why does a man live in a town?" he asked himself. Then he grinned. "Oh, what's the use—what would I do without a lot of cars to fool with?"

His nimble imagination went to work on the problem of Mel's truck, and by the time he had turned into the poplar-bordered lane that leads to the Mowbray house he had thought of half a dozen things that might be the matter with it.

Gus stopped his car in the barnyard. Mel, glumness written all over him, was standing there with a stoop-shouldered, hatchet-faced man who obviously was laying down the law. As Gus got out and walked toward them, he heard Mel say: "Here's the man who can fix it if anyone can."

"He'd better fix it quick if you expect to sell them termaters to me!" the sharp-faced man snapped. "I ain't goin' to tie up my whole works jest because you don't live up to your contract. If you ain't got 'em there by startin' time tomorrer mornin' I'll buy Zack Brown's crop, and you can sell your'n any place you can."

He gave Gus a hard-eyed look, stalked over to a shiny new sedan, and drove down



Mel's lane and onto the gravel road below.

"That's Duggins," Mel explained. "He owns the cannery, and he's a hard man to do business with. The price has dropped since he bought my crop standing, and he'd be glad of an excuse to get out of the deal. It would be pretty bad for me—I've counted on that tomato money."

"Cheer up," Gus encouraged. "Most balky trucks can be made to run. Where's yours?"

Mel pointed to a tomato-heaped 1½-ton truck standing at the edge of a field near several big piles of picked tomatoes. Hospitality and anxiety fought a battle in his face—and hospitality won.

"Mary's got supper ready," he said. "Let's eat. You can look at the truck later."

In the farmhouse kitchen they found buxom Mary Mowbray, her cheeks a shade redder than usual, waiting for them. Short notice hadn't kept her from setting a supper fit for any hungry man's appetite.

As Gus was finishing his second ample helping of deep-dish apple pie, they heard a car stop. A moment later a young man in a snappy summer suit and black-and-white sport shoes came in without knocking. He looked suspiciously at Gus, who recognized him as Elmer Peters, the smart-alecky proprietor of the near-by crossroads garage.

"Hello, folks," Elmer breezed. "Can't stop to eat with you. I'm as busy as a one-armed paper hanger."

He waited expectantly for a laugh and, when it didn't come, went on: "Dad Duggins stopped by and told me your truck's down, Mel. I don't see what can be the matter; it was O.K. when it came out of my shop. *That* I know—I went over it myself. But I'll take a look."

"All right," Mel agreed slowly. "Want to come along, Gus?"

As they followed Elmer out, Mel whispered: "I'd sure like to tell him what I think. Reborning the block, new pistons, new rings, new valves and guides, new bearing inserts—that overhaul cost a lot. But I don't dare; he's married to Duggins' daughter, and I can't afford a row now."

They walked over to the truck. "I left it right here in the field," Mel volunteered. "It sounded like the motor was tearing itself apart, and I didn't want to drive it out."

Gus watched silently as Elmer raised the hood and made a cursory inspection.

"Can't see anything wrong," the local garageman said. "Start 'er up."



Mel climbed behind the wheel, switched on the ignition, and pressed the starter button. The engine took off promptly, but there was a loud thumping noise and the truck shook so violently that he had a hard time keeping his seat.

"Shut 'er off—quick!" Elmer yelled, and Mel cut off the engine.

"Whatever it is, it's right here under the seat," Mel told him. "I can feel it."

Elmer scratched his head and looked helpless. "That's a new one on me," he admitted. "It must be a bearing burned out. I'll have to take the motor apart to find out. Probably ain't our fault, but if it is, I won't charge you a cent, Mel. You tow her over in the morning. Don't try to drive her."

"Can't fix it tonight?" Mel asked.

"Not a chance," Elmer answered airily. "My mechanics have gone home, and I can't do it myself. Gotta take my wife to a social at Dad Duggins' place."

Gus, who had been staring silently at the truck engine, decided that the time had come to take a hand.





Gus wriggled out from under the engine. "What's happened to the pan under the front end?" he asked.

"It could be," he cut in, "that the trouble is something easier found and fixed than a burned-out bearing."

Elmer turned, with a sneer. "You an expert on truck motors?" he demanded.

"I've had a little experience," Gus admitted. "Switch on the engine, Mel."

"You're apt to ruin it," Elmer warned. "I won't be responsible if you do."

Mel looked at the young man, and then at Gus. He stepped on the starter button. The loud thumping began immediately.

"Listen!" Elmer yapped triumphantly.

Now, Mel's truck has two fan belts. Gus pointed at one of the pulleys. On each of its revolutions the belt going round bulged out sharply at one spot.

"So what?" Elmer asked scornfully.

"I'll show you what," Gus told him. "Cut the engine, Mel."

Instead of going at the fan belt, Gus got down under the front end. After a minute, he wriggled out again and got up.

"What's happened to the pan under the front end of the engine?" he asked.

Elmer turned red. "It was badly rusted, so I didn't bother putting it back," he explained. "Wasn't any use, anyhow."

"Oh, no?" Gus said. He got a screwdriver from the toolbox and gently pried a piece of a twig the thickness of a pencil from under the belt. "Start her up again, Mel," he said.

This time there was no vibration. Mel grinned. Elmer's mouth sagged.

"Just one of those things, Mel," Gus laughed. "You must have run over some brush, cut off this piece with the fan belt, and had it forced into the pulley V-groove. It couldn't have happened if that pan had been put back after the overhaul."

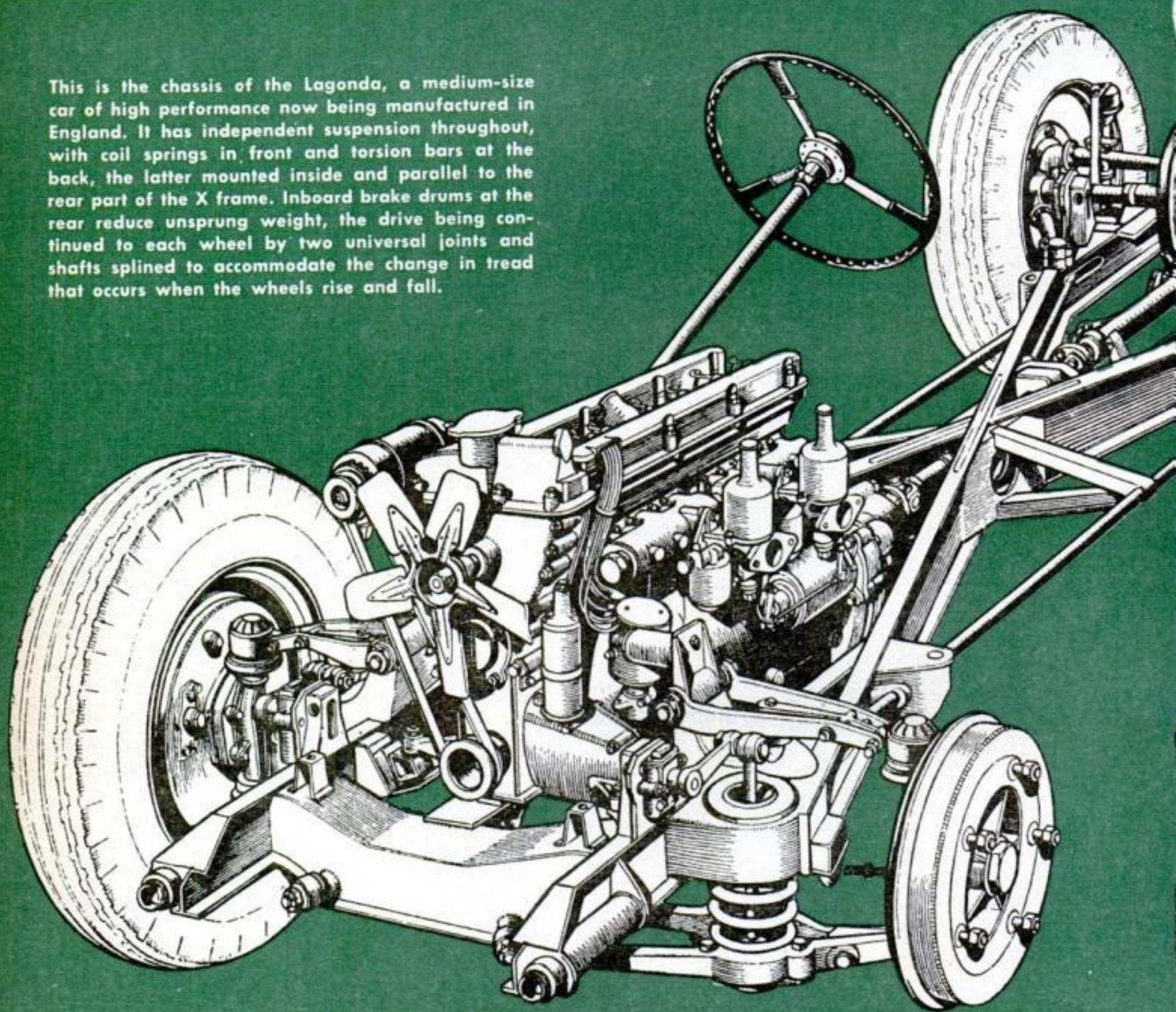
He stifled an impulse to chuckle at the look on Elmer's face. "Well, you're all right now, and I've had some of Mrs. Mowbray's apple pie. You drive that load of tomatoes over to the cannery, and when you get back I'll help you with more. . . . You'll be seeing your father-in-law this evening, Mr. Peters. Tell him he'll have plenty of tomatoes to get started on in the morning. Mel *wouldn't* want him to worry." END





With clean lines and built-in headlights, the 1947 Jowett "Javelin" has a decidedly American appearance.

This is the chassis of the Lagonda, a medium-size car of high performance now being manufactured in England. It has independent suspension throughout, with coil springs in front and torsion bars at the back, the latter mounted inside and parallel to the rear part of the X frame. Inboard brake drums at the rear reduce unsprung weight, the drive being continued to each wheel by two universal joints and shafts splined to accommodate the change in tread that occurs when the wheels rise and fall.





# British Cars—Mechanical Marvels

By R. P. STEVENSON

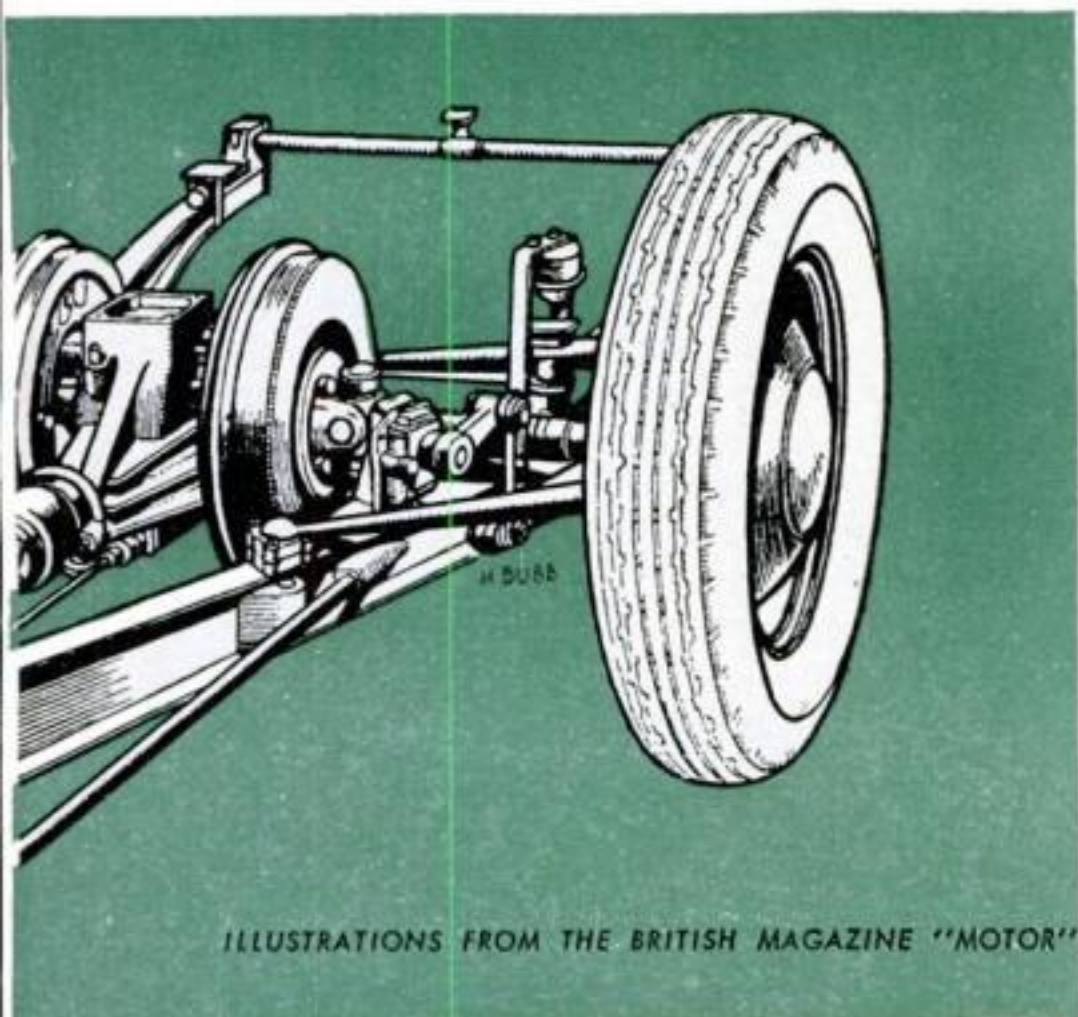
ENGLAND'S auto manufacturers are beginning to make up the time they lost during the war. Because the American motor industry was able to continue improvement of its product for two years after England shifted to a war basis in 1939, the first British postwar cars appeared quite out of date in comparison with ours when manufacturers in both countries returned to peace-

time production. But now the British are producing some impressive new models, and it may not be long before they again will be showing us a trick or two in design, advanced engineering, and gadgetry—as they frequently have in the past.

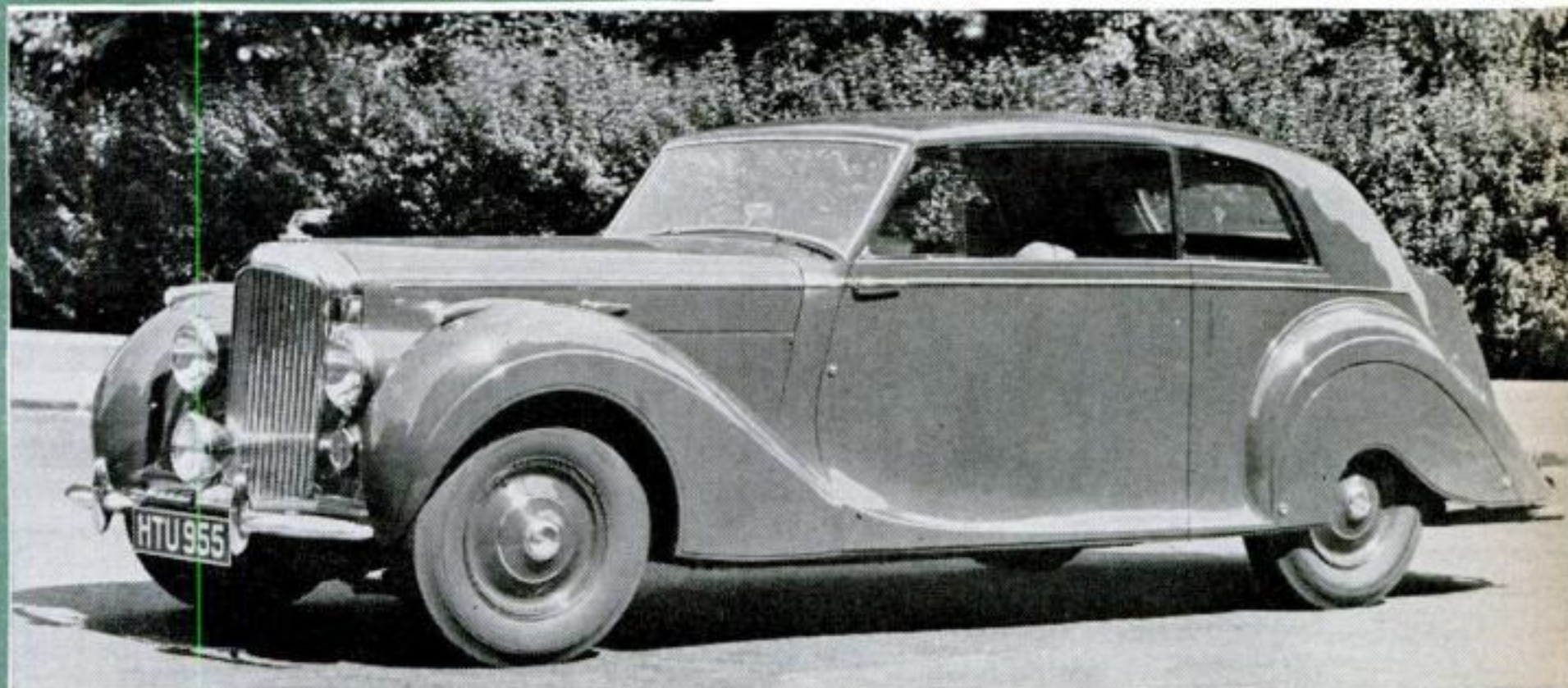
Indicative of British advances are the 1947 Invicta Black Prince and the new Lagonda. Roughly comparable to American light cars in size and power, these have six-cylinder twin overhead-camshaft engines and independent suspension of all four wheels. The Black Prince also boasts an automatic transmission. Both are strictly luxury products, the Invicta selling for about \$12,000, tax included, and the Lagonda for around \$7,000.

A third interesting new car is the Jowett Javelin. Selling for less than \$2,000, it falls into the class of small cars that comprise the bulk of British production, its wheelbase being 102", tread 51", overall length 164", and overall width 61". But despite this small size, a wide streamlined body accommodates five persons comfortably—and six on occasion. Powered by a four-cylinder horizontally opposed engine that develops about 50 hp., the Jowett has a maximum speed somewhere around 80 m.p.h.

Owning any car in England is a costly proposition. Hand-production methods help keep basic prices high, and to these an own-

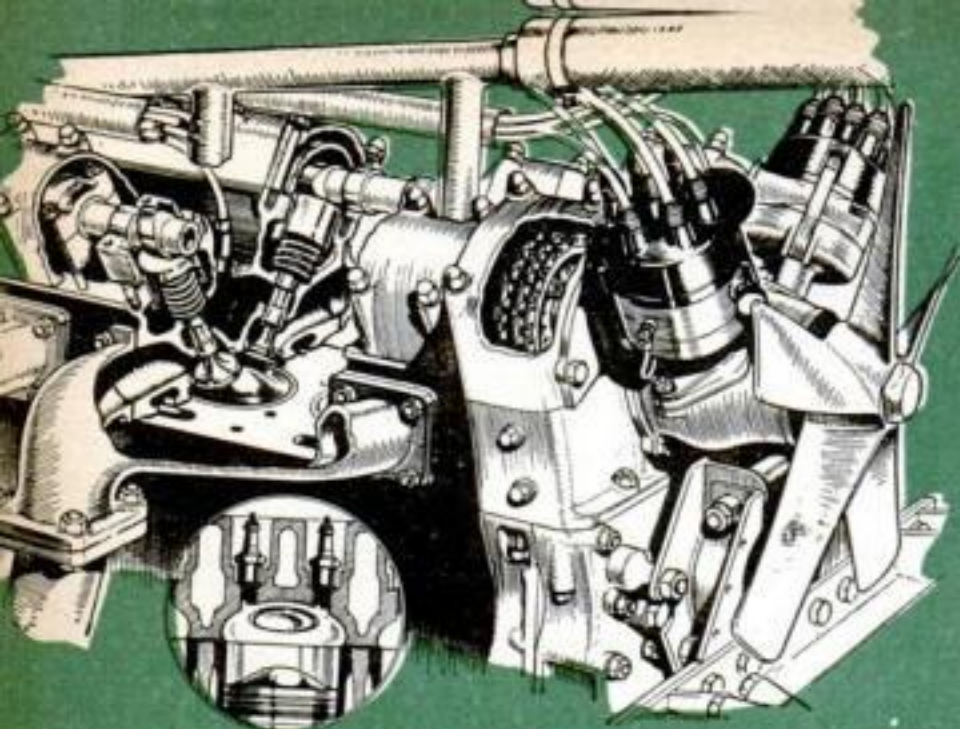


ILLUSTRATIONS FROM THE BRITISH MAGAZINE "MOTOR"

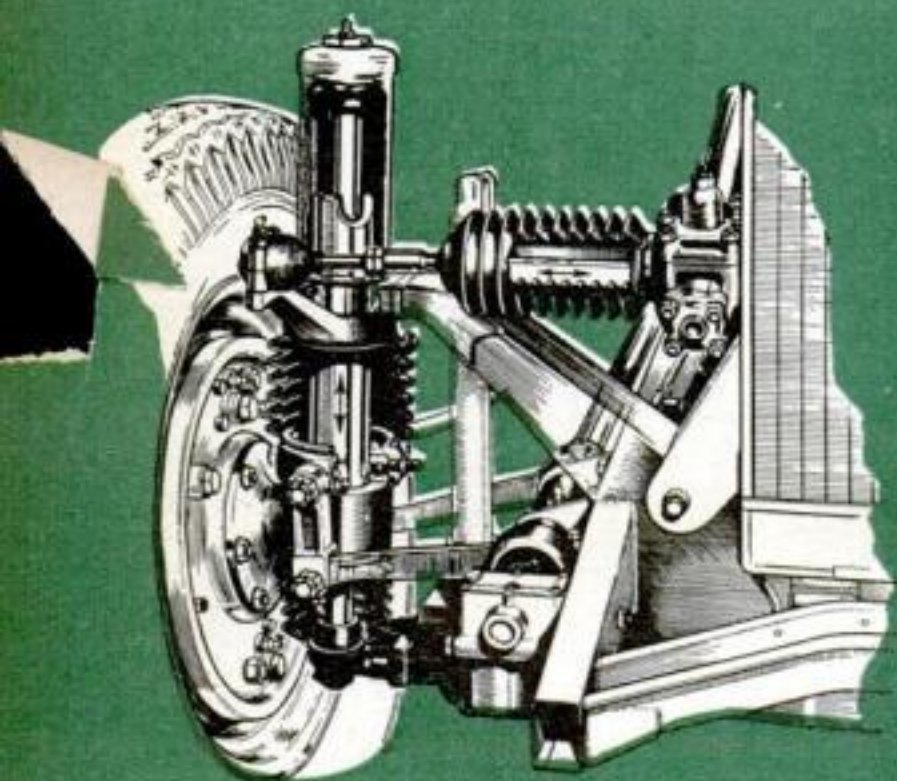


One of Britain's highest priced cars, this Bentley Mark VI sedan sells for about \$17,500, including tax.

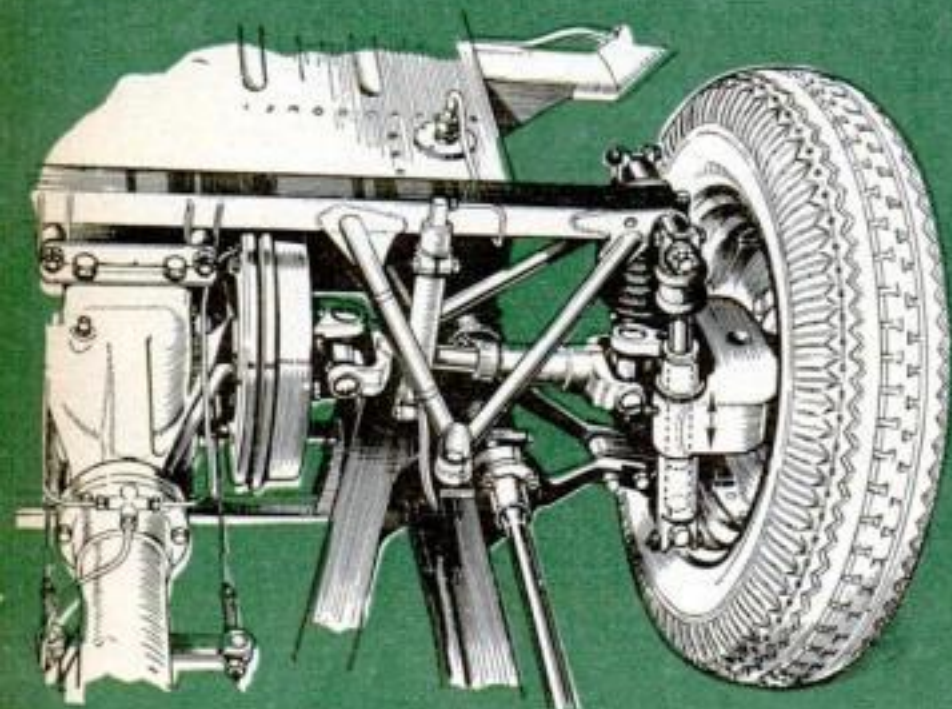




A six-cylinder overhead-camshaft engine powers the Invicta Black Prince. Twin timing chains from the nose of the crankshaft drive the two camshafts. Each cylinder has two spark plugs.



Independent front springing on the Invicta is provided by a torsion bar linked to a kingpin that slides on a vertical pillar. The torsion bar lies just outside the side frame member.



Transverse wishbones and telescopic members are combined in the independent rear suspension. The brakes are mounted on the differential assembly.

er must add a heavy purchase tax and annual taxes of more than \$4 per horsepower. The least expensive car by far is a British-made Ford, the four-cylinder Anglia model that develops only about 30 brake horsepower and sells for nearly \$1,200. For the medium size and larger British cars, the range shoots sharply upward. Priced at \$12,000, the new Invicta Black Prince ranks below only the Bentley models, ranging between \$13,000 and \$18,000, and the Rolls-Royce, which costs between \$17,000 and \$19,000, depending on the model.

The Rolls-Royce, long a symbol of luxury, is advertised as "the best car in the world." This may not be overstatement, for this car and the almost equally famous Bentley and Daimler are products of the highest type of workmanship and skill. In the Rolls-Royce and Bentley, both of which have chromium-plated cylinders, the objective is a minimum life of 100,000 miles for all engine components.

Because of the production cost, the taxes, and the fact that the general purchasing power is low, less than 8 percent of the cars produced in England equal the popular American car in size, and three-fourths of the entire output have four-cylinder engines that develop less than 48 brake horsepower. Most of the four-cylinder engines are of the overhead valve type. In general, British engines develop relatively high horsepower for their size, and are designed to run at higher speeds than American engines.

Since gasoline is costly and still rationed, the Englishman naturally is concerned with getting the highest possible mileage. Consequently, the manufacturers of small British cars are constantly seeking technical improvements that will lift the miles-per-gallon figure to the highest possible point. Many of the small cars give as much as 30 and 40 miles to the gallon.

Most British cars still look a great deal like the American product of the middle Thirties, but there are indications that streamlining soon will take hold. It probably will be based largely on aerodynamic principles and not just appearance alone. The new Jowett has a decidedly American appearance, while both this car and the Healey give consideration to the problem of better forward visibility by using hoods that slope downward toward the front.

British transmissions generally provide four forward speeds. Single dry-plate clutches are almost universal except for the



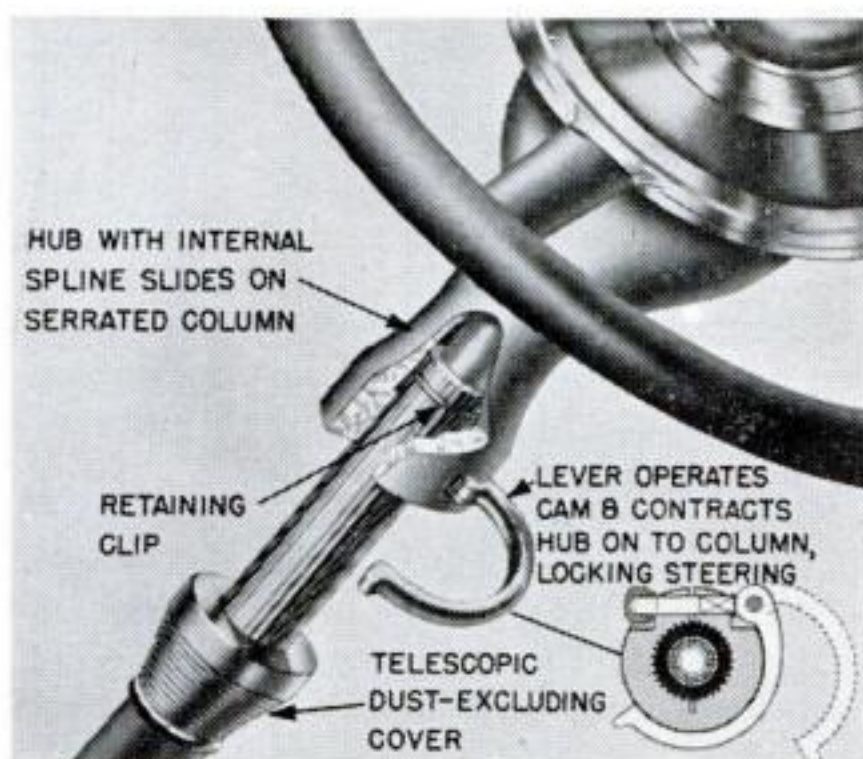
famous Daimler fluid flywheel (also now found in the Lanchester and Armstrong Siddeley) and the automatic transmission this year in the Invicta Black Prince. Most British cars still retain a floor gearshift lever, but there is a trend toward locating it on the steering column, Standard having moved the lever to that position on its 1946 Triumph 1800 and Jowett locating it there this year. With an automatic transmission, this year's Invicta, of course, dispenses with both gear lever and clutch pedal.

Automatic and semiautomatic transmissions now in use in the United States owe a big debt to the Daimler fluid flywheel. This was employed in Britain for several years

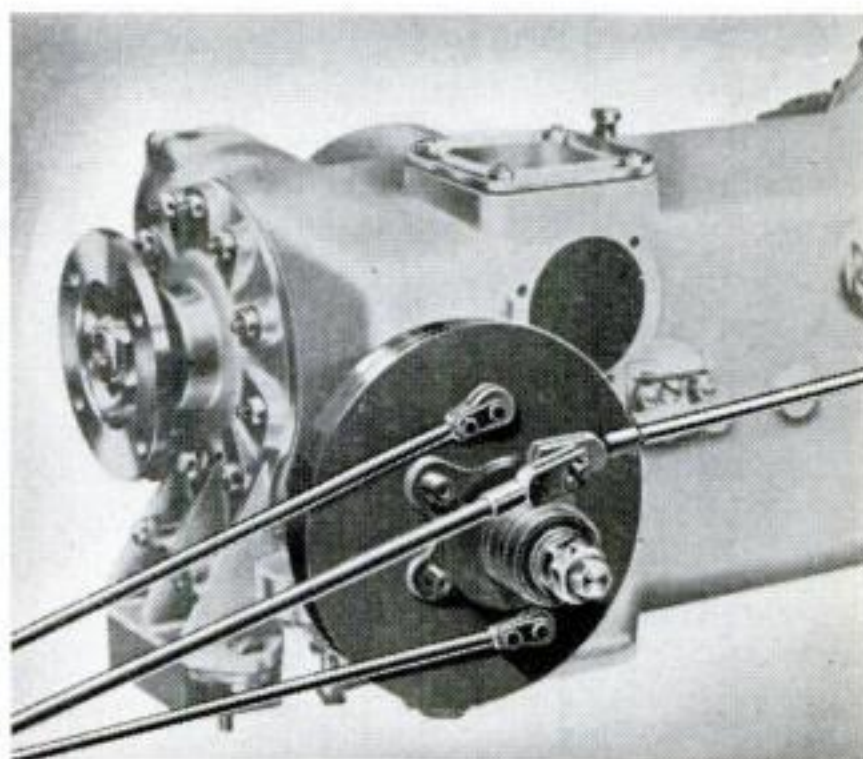
before a fluid or hydraulic drive appeared in the United States.

Now the British have taken what eventually may prove to be another forward step. Instead of an automatic transmission of the American type, the Invicta designer has used a hydraulic torque converter. (Ordinary torque converters, incidentally, are found in many American buses.) Basically a two-stage oil-driven rotor with free-wheeling in the upper stage, the hydraulic torque converter provides a transmission combining the functions of an hydraulic coupling and infinitely variable gear between a top ratio of 4.27 to 1 and a bottom of approximately 15 to 1. For reversing, an epicyclic gear is lo-

## GADGETS MAKE LIFE EASIER FOR THE ENGLISH MOTORIST



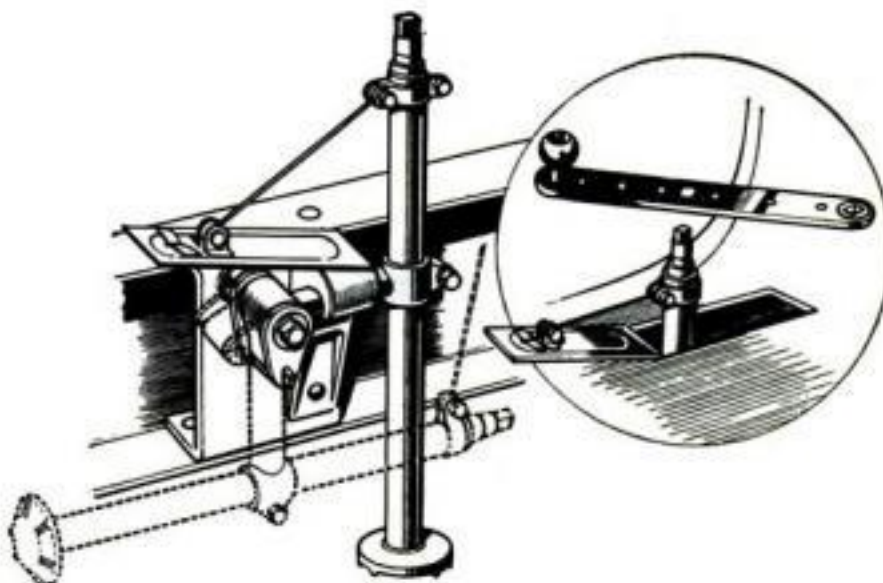
To suit drivers of different height, some British cars offer adjustable steering wheels as well as adjustable seats. The steering wheel illustrated here is manufactured by Bluemel Brothers, Ltd.



On all Rolls-Royce cars, a friction servomotor, driven off the rear of the transmission at 1/30 engine speed, boosts brake-pedal pressure. In one Daimler model, a vacuum servo does the same job.



In common with European autoists, the British like a roof that slides open to let in sunshine. This is a Morris Eight, typical of British small cars.



Most British cars have built-in jacks, some being hydraulic and some mechanical. The type above is reached and operated through a panel in the floor



cated at the rear of the torque converter. A control switch with forward, neutral, and reverse positions is placed on the instrument panel.

In operation, the Invicta transmission shifts effortlessly through all ratios like the American Hydramatic, with the driver needing only to accelerate or decelerate as the occasion requires. With the hydraulic torque converter, slip loss is high in the lower ratios, but the loss gradually descends with increasing speed under direct drive conditions. In the first tests, the Invicta reached a speed of about 75 m.p.h. with ease.

Equipped with a centrifugal automatic clutch and four-speed transmission, the new Lagonda enables the driver to shift either with or without using the clutch, the change being made with a small ball-and-socket gear lever projecting from the instrument panel. To shift without the clutch, the accelerator must be manipulated to bring engine speed to the proper point. The Lagonda is capable of a speed of 90 m.p.h., has a cruising speed of 76, and gives over 22 miles per gallon.

It may be more than coincidence that both the Lagonda and Invicta employ six-cylinder twin overhead-camshaft engines. Of the two, the Invicta has the more unusual features. It has two spark plugs per cylinder, three main carburetors and two auxiliaries for starting, and twin exhaust manifolds. The inclined overhead valves are driven directly from the camshafts, and two timing chains from the nose of the crankshaft drive the camshafts. Camshaft whip is eliminated by

supporting each shaft in 12 bearings. The Invicta engine is rated at 24.4 hp., making it approximately equal to an American car of 100 brake hp.

Independent suspension of all four wheels is a notable feature on both of these, new British cars. On the Invicta, the actual springs are four long torsion bars located outside the side frame members. On the Lagonda, torsion bars are used at the rear, coil springs in front. An examination of the two rear suspensions reveals an unusual feature common to both—the brake drums have been moved inward to either side of the differential housing. This reduces unsprung weight and eliminates the need for flexible brake linkages. Since the rear wheels are independently sprung, the differential housing can be attached solidly to the frame. Consequently, the drive shaft does not rise and fall.

Both cars also depart from the general custom of recent years in the matter of steering. In each case, the transverse movement is obtained with a helical rack-and-pinion mechanism. One of the original methods of steering in the early days of the automobiles, this has been regaining considerable favor in England in recent years.

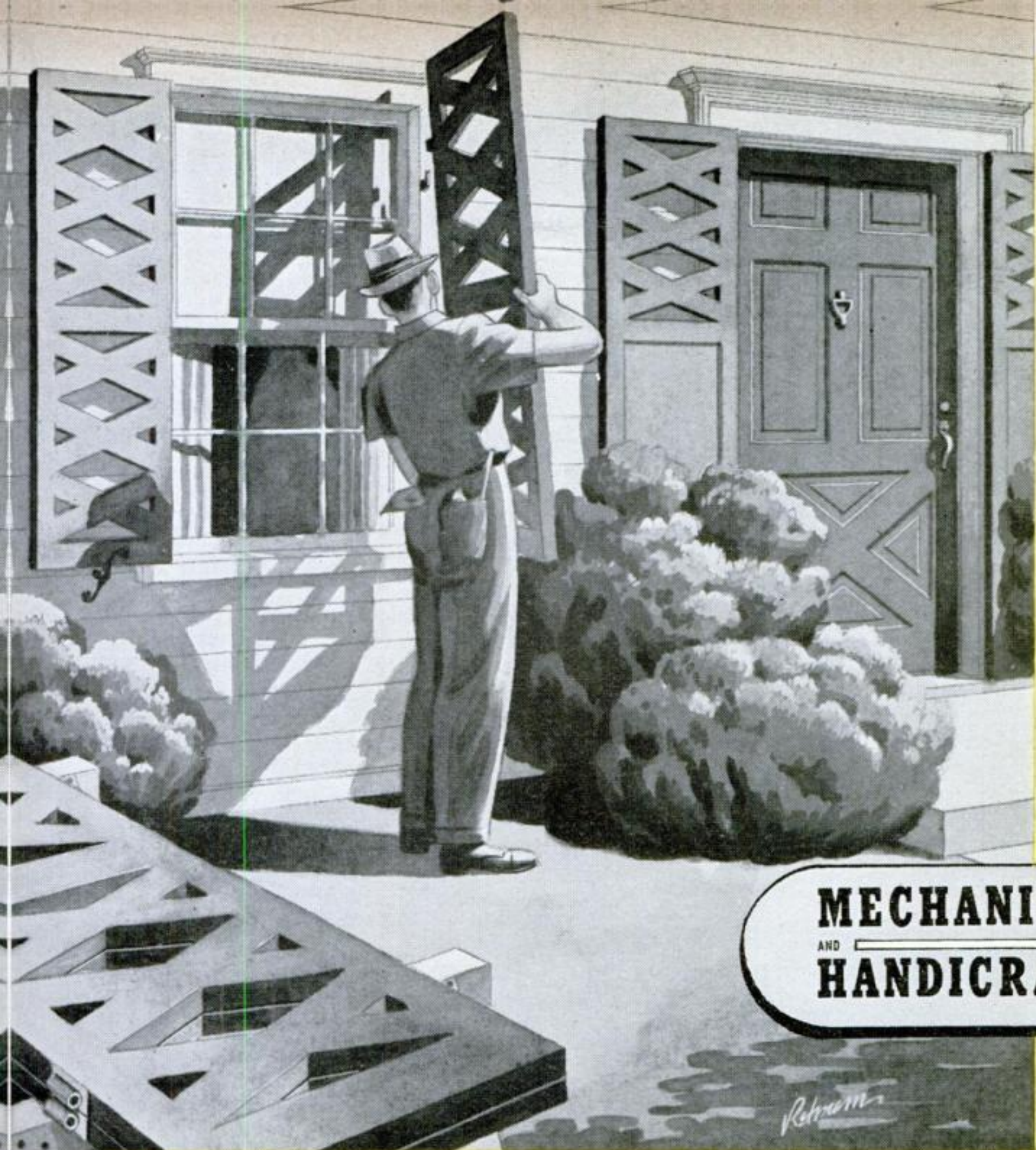
While many American manufacturers rely on steel bodies to help give their cars overall strength, the Invicta and Lagonda designers both put their faith in a rugged cruciform frame on which a stiffening flat floor is mounted. On this floor is fitted a light body that has as its only purpose the protection of the passengers.

END



In England, Fords are by far the least expensive cars. This is the Prefect model, selling for about \$1,400.





## **MECHANICS AND HANDICRAFT**

- Distinctive Window Shutters
- Jet-Propelled Model Racer
- Fisherman's Electric Outboard
- Packaged Radio Power
- Vacuum Cleaner as a Power Tool



# Shutters Add

**By Hi Sibley**

**W**INDOWS are the eyes through which your house looks out on the world; what the world sees when it looks back depends upon your decorative skill and ingenuity. For purposes of exterior decoration, shutters have few rivals. They break up blank wall spaces and lend distinction and personality to the house. Half a dozen simple designs are shown on these pages, and any of them can be readily built in the home workshop.

The picture at the upper left shows a shutter made of crossed rails bound by a frame of  $\frac{3}{8}$ " by  $1\frac{1}{2}$ " stock mortised and tenoned at the corners. Short tenons are used on the center rails to keep them from going through the side members. The crossed rails are put together as shown in the sketch on the facing page.

A familiar slat type of shutter is shown in the same drawing and in the photo that adjoins it. The slats are glued into 45-deg. grooves and covered with strips. Cross-pieces above and below the center panel are tenoned into the stiles. A sheet of waterproof plywood or other thin stock is then set into the rectangle thus formed to provide a backing for curved corner pieces and a jigsawed rosette.

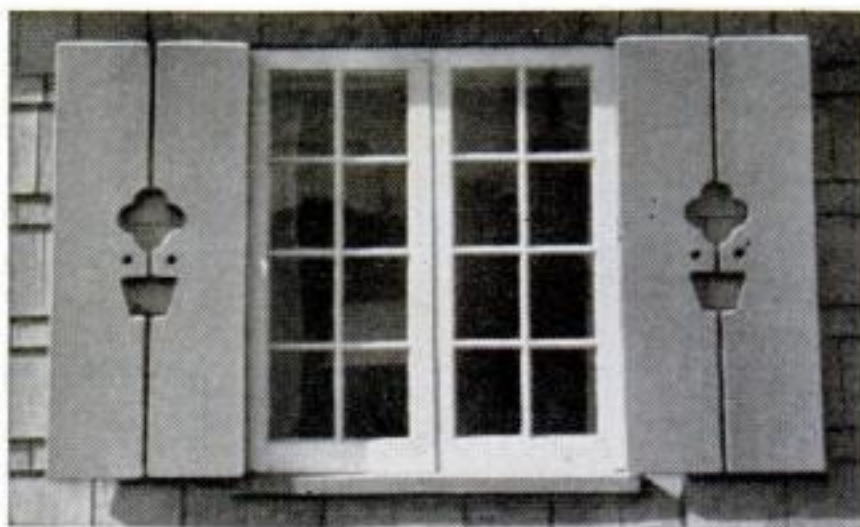
The remaining shutter designs pictured here are all variations of the slat-and-batten arrangement. Two or more boards of uniform or alternating widths are joined by battens either in front or in back to produce these varied effects.



The crossed-rail shutter as used here effectively sets off the Venetian blinds within. In color it complements rather than contrasts with the wall.



Three wide and two narrow boards are joined by a pair of slanting battens to produce this shutter suitable for almost any light-walled cottage.



These shutters are battened from behind, one strip being placed across the top and another across the bottom. The pattern is given on squares at right.



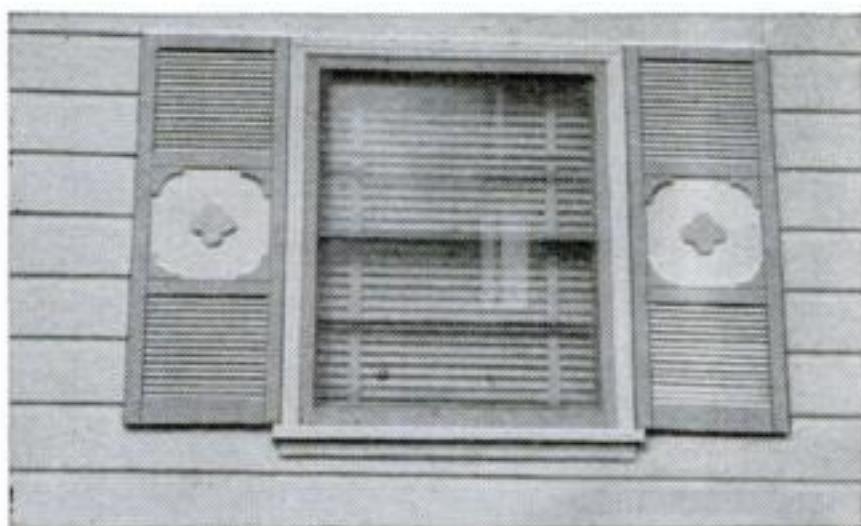
# Personality to Your House



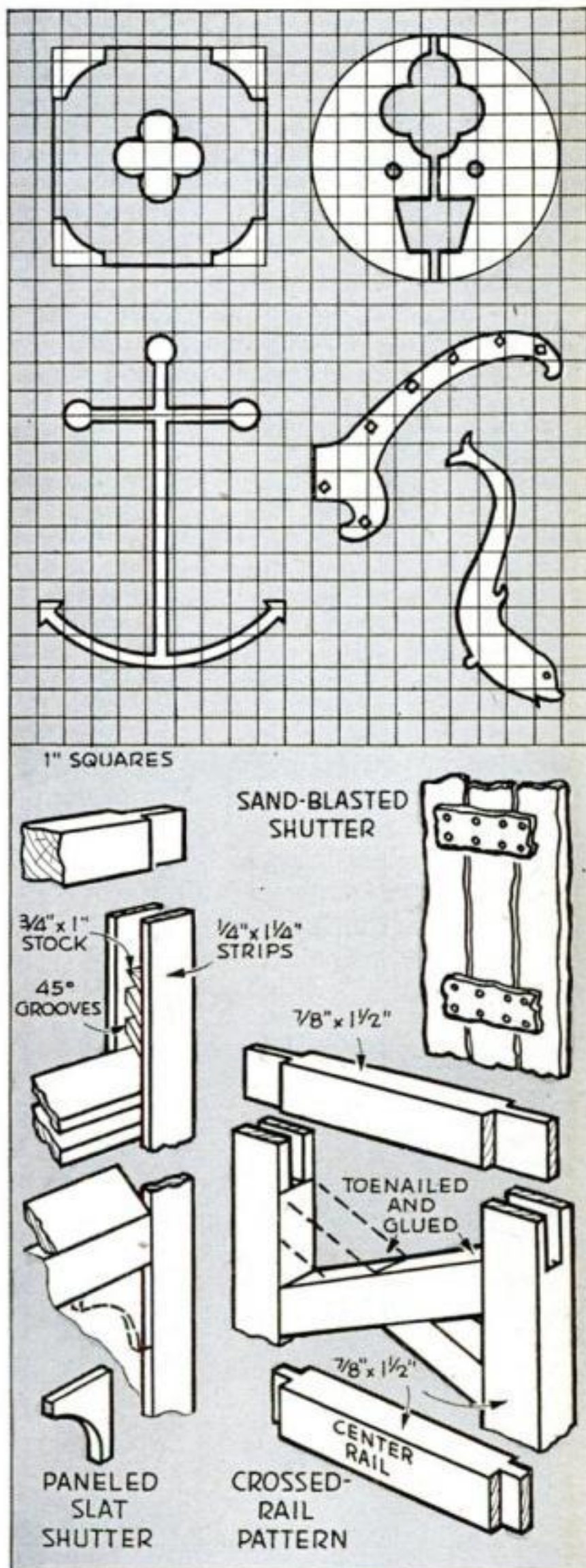
For beach homes the marine designs above and below are particularly appropriate. In the anchor above, free pieces are held by batten in back.



The dolphin is cut out of two of the three boards used in this shutter; an ornamental hinge serves as the top batten. It is fastened with lag screws.



This old-fashioned slat-type shutter is relieved by a decorative center panel. A backing of water-proof plywood is glued between the center rails.



Details of the paneled-slat and cross-rail types are shown above. A weathered effect may be obtained by sand-blasting or partly charring with a torch.



# Whizzing Racer Is Jet Propelled

**By Joe Bell, Jr.**

WHEN you release the gas from this slick little 8-oz. racing car, step back. It should be speeding down the straightaway at 50 m. p. h. within 100'. If you puncture the jet exhaust properly, it will hold that speed for another 100' or more.

The fast little three-wheel racer is made from standard model-plane materials that can be obtained at any model-supply shop. It is propelled by the discharge from a carbon dioxide cartridge of the kind used to charge home soda bottles. Held to its course by a stretched guide wire, it will run up to 240' on a single charge. The futuristic-looking model is shown in full color on page 128.

To form the body cover, soak a 1/16" by 4 1/2" by 6 1/2" piece of soft sheet balsa in hot water until it is pliable, bend it around a 1 1/4" diameter dowel or broom handle, wrap loosely with gauze, and let stand until thoroughly dry. Cut the bulkheads A, B, and C from 1/8" medium balsa sheet, notching A for wheel clearance.

The laminated nose is made of seven pieces of 1/4" soft balsa. While the block is still in its rough shape, cut out clearance for the front wheel. The tail block is made from three pieces of 1/4" soft balsa, one piece being

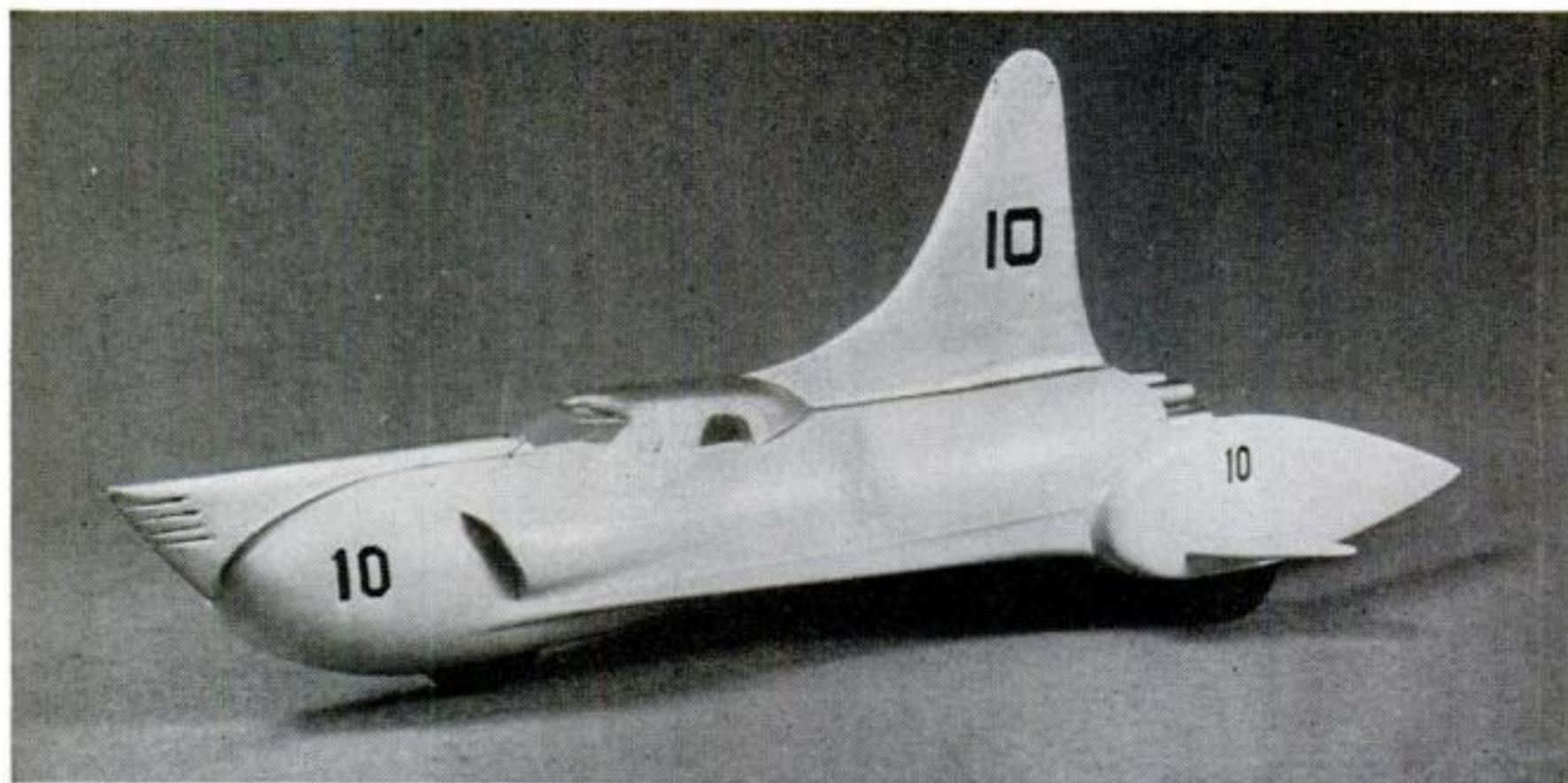
the same size as the bulkheads and the others 1/8" larger in diameter. Cut a 3/8" hole in each. Glue the three together and leave in rough form.

Make the jet chamber by soaking a piece of 1/16" sheet balsa in hot water and wrapping it loosely around a soda-bottle cartridge. Wrap with gauze until dry. Glue up the seam, cement a plug of 1/8" hard balsa sheet in one end, and glue the chamber into the hole in the tail block. Cartridges should fit freely so they can be changed readily.

Wheels are made of 1/16" three-ply plywood. Cut three disks 1" in diameter and six 1/2" in diameter. Sand all to perfect circles and glue 1/2" disks on both sides of the 1" disks as hubs. Drill the centers to turn freely on the wire axles.

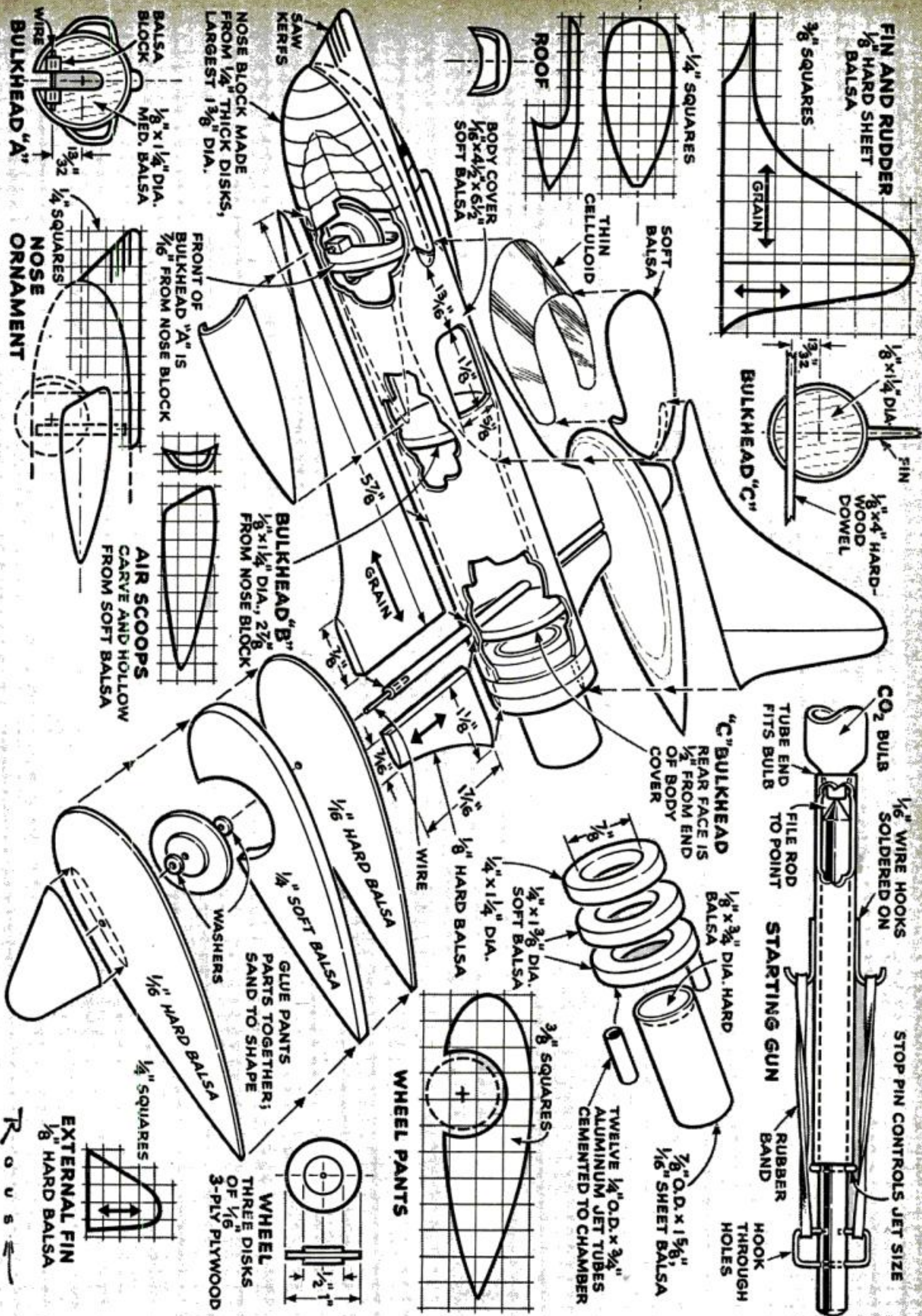
Assemble one wheel on bulkhead A with washers on both sides and glue securely. Then glue the bulkheads and the nose and tail blocks into the formed body cover, making sure that the clearance slot provides completely free movement for the front wheel. Sand the nose and tail to shape.

Drill the ends of a 4" length of 3/8" hardwood dowel for a press fit for the axle wire, and drill through the body just ahead of bulkhead C to take the dowel. Insert and



As speedy as it looks, this little balsa racer will do up to 50 m. p. h. for a distance of 200' or more.





All parts of the car are made from standard stock that can be obtained from any model-plane supply shop.



glue in this part of the axle, checking carefully for true alignment.

Cut the cockpit opening in the top of the body. Carve and sand a  $\frac{3}{4}$ " by 1" by  $2\frac{1}{2}$ " block of soft balsa to shape for the roof, glue in place, and let dry.

The horizontal fins are cut to shape from  $\frac{1}{8}$ " hard sheet balsa, sanded, and the edges rounded. Note that the grain in the forward fins runs front and back, and that in the rear at right angles. Glue the fins in place, taking care to check alignment.

Air scoops are carved and hollowed from two  $\frac{3}{8}$ " by  $\frac{3}{4}$ " by  $2\frac{1}{4}$ " blocks of soft balsa, glued on the body, and sanded smooth. The wheel pants are glued up from pieces cut from  $\frac{1}{4}$ " soft sheet and  $1/16$ " hard sheet, sanded to final shape, and glued in place with several coats of glue for added strength.

Cut the vertical fin and rudder from  $\frac{1}{8}$ " hard sheet, again noting the change in grain direction. Sand to final shape, align carefully, and glue in place.

Put the wheels in the pants, push wire axles through them and washers and into the drilled holes in the dowel, and then glue and let dry. Cut the outer fins from  $\frac{1}{8}$ " sheet and glue on in good alignment.

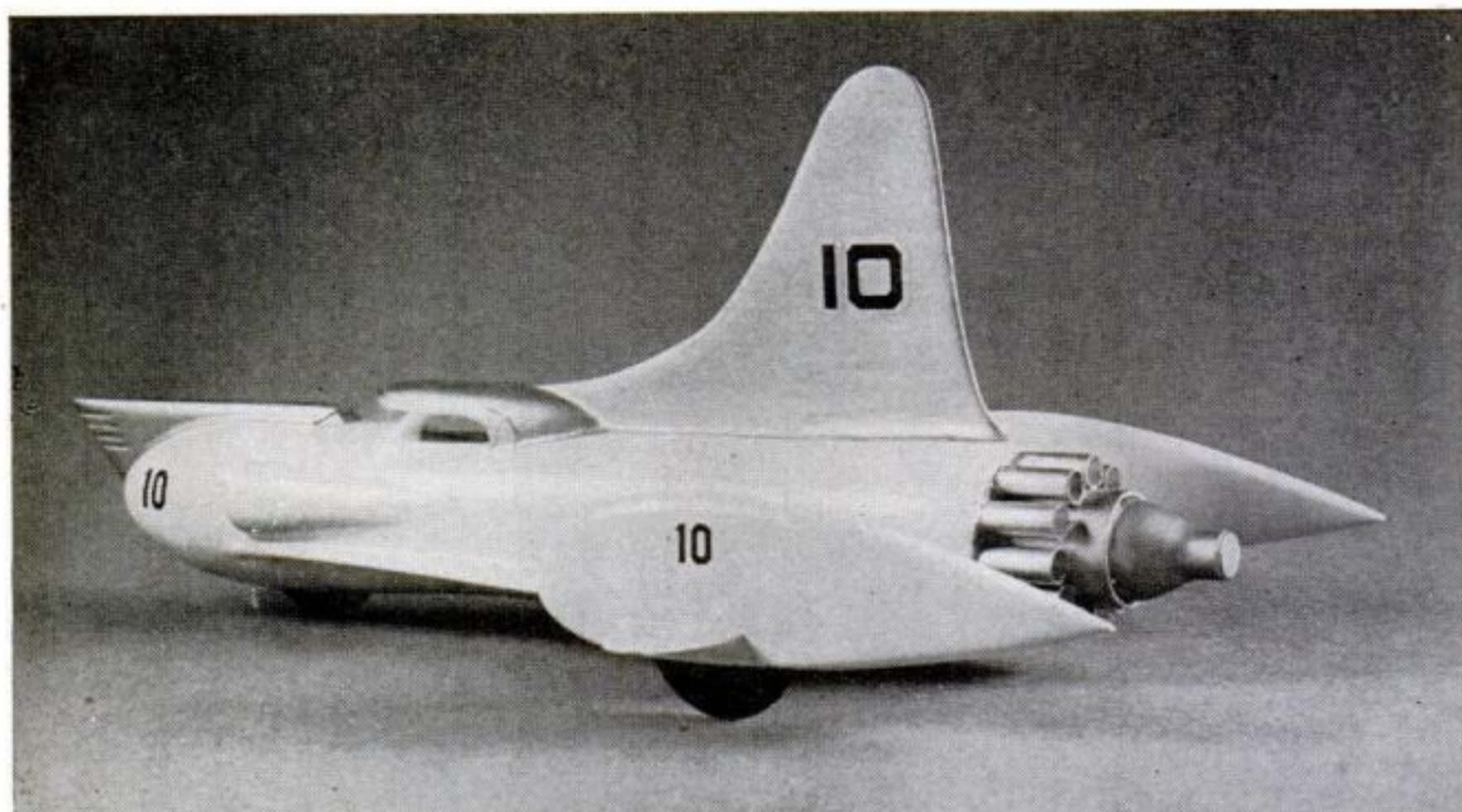
The nose ornament is cut from  $\frac{1}{4}$ " hard sheet balsa, tapered toward the front, and kerfed for appearance. Glue on and sand. Then seal all exposed surfaces with a wood filler or sanding sealer to assure a smooth finish, and paint to suit.

Jet tubes are next made of  $\frac{1}{4}$ " O. D.

aluminum or other tubing, or from lengths of malted-milk straws, and cemented into  $\frac{1}{4}$ " holes in the tail block and to the jet chamber. The nose ornament is slotted for the windshield, and paper is fitted in until, by trial and error, a template is obtained from which the celluloid windshield is cut. It is glued in the slot and to the body and roof.

The gun is simple to make. Fit a solid rod loosely into a metal tube having an inside diameter that goes easily over the end of a carbon dioxide cartridge. Sharpen the firing end of the rod to a needle point. Solder wire hooks and a stop pin to the tube. Then fit a hooked wire into holes drilled in the butt end of the firing rod so that when the wire is pulled to either side it will expose an opening through which a rubber band can be slipped. Loop the bands over the hooks on the side of the tube.

To keep the car on its course when it is in operation, stretch a guide wire the required distance and run it through screw eyes put in at two aligned points on the car. Have a friend hold the car down with one finger, and then pull back the trigger of the starting gun, touch the firing end gently to the cartridge, and release the plunger, which should be adjusted so the needle makes the tiniest hole possible. The smaller the hole, the faster and farther the car will go. Lay a folded carpet at the end of the course as a cushion to stop the racer gently, or it may be smashed to bits on its first trial run. **END**



Here's the action end. The jet is a soda-bottle cartridge ringed by tiny "exhaust" tubes for appearance.



## Turned Lamp Is Oil Finished

**By William J. Ward, Jr.**

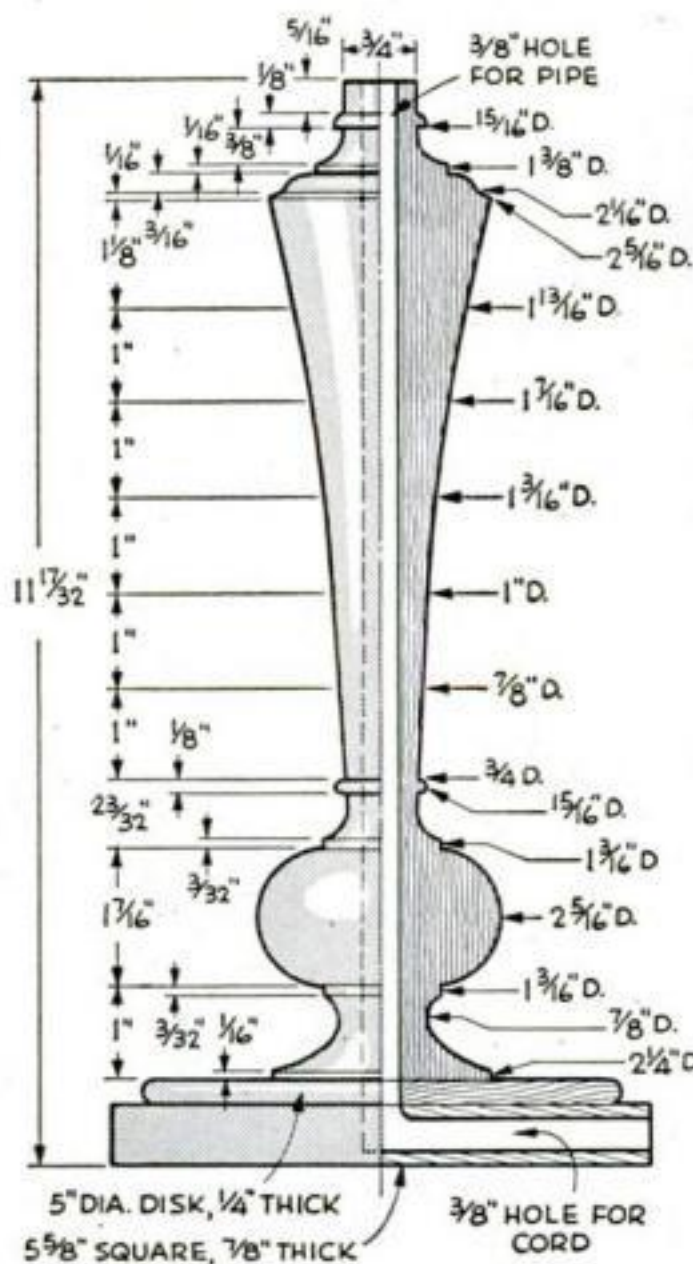
TO PRODUCE work that has the quality of mellow age while still quite new is one of the hallmarks of the master craftsman. This lamp meets that test, not only in the semblance of a patina that frequent rubbing with linseed oil gives, but also in the simple turned design. It would look at home in the company of many genuine antiques, particularly in a living room furnished in Early American style.

Except for the square plinth base topped by a round-edge disk, the lamp is an accurate copy of a ball-and-trumpet leg of a William and Mary highboy. Turn the piece from any good cabinet wood, trying the contour from time to time with a template made to the dimensions in the drawing. Bore through from both ends and screw in a  $\frac{1}{8}$ " pipe nipple at the top of the column.

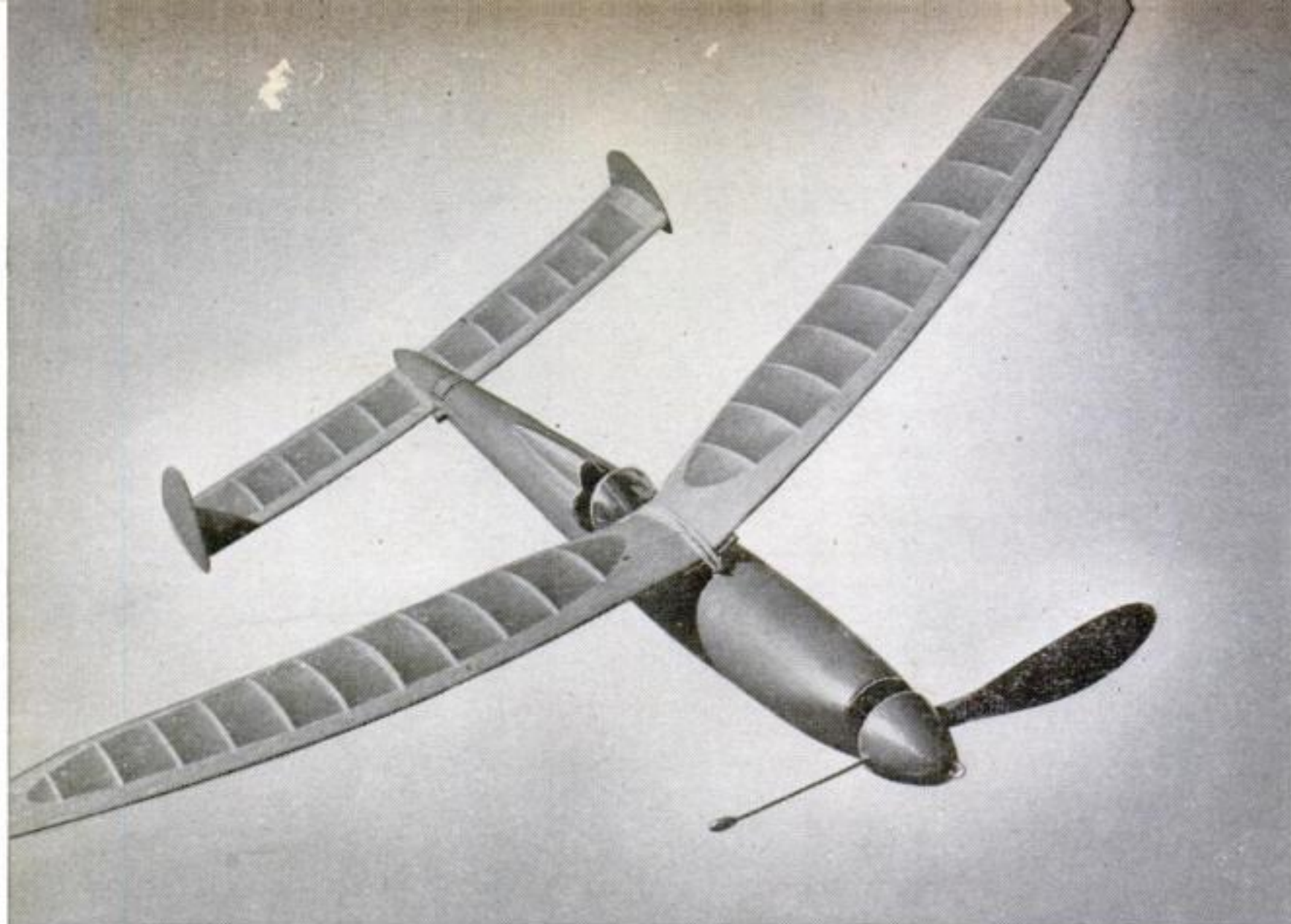
Walnut was used for the lamp shown, and it was sanded repeatedly with successively finer grades of garnet paper to 6/0. After each sanding, the piece was wiped with a damp cloth to raise the fine hair fibers in preparation for the next finer sanding. Finally double-boiled linseed oil was applied, as the old formula has it, "every day for a week, every week for a month, every month for a year"—and now every year for life.

Linseed oil will darken the wood considerably. A finish that will keep the wood light is beeswax melted in turpentine and applied hot at the consistency of thick cream. Prepare the mixture carefully in a double boiler set over a low flame, since both beeswax and turpentine are highly inflammable.

A handsome lamp can be made of mahogany, maple, or other good hardwood instead of walnut if one of these is more appropriate. Any can be finished dark with boiled linseed or blond with wax and turpentine.







Here's a rubber-powered model that will reach out not only for altitude, but for real distance as well.

# The Chieftain Hits the Ceiling

**By Paul Mueller**

**T**HIS rakish plane, the Chieftain, is a flying model designed for clean appearance and good flying qualities. Construction is much less complicated than it may seem. The retractable landing gear and folding propeller lessen drag when in the air. A color shot of the plane as it might look in flight is shown on page 128.

Glue up two 1" by 2½" by 21" blocks of soft balsa with paper between them, and then carve the outer shape of the fuselage, turning the piece in the hands often to aid in obtaining concentricity. Then split the two halves apart and hollow out the inside with a gouge to 3/32" thickness except at the nose. This is the hardest part of the job.

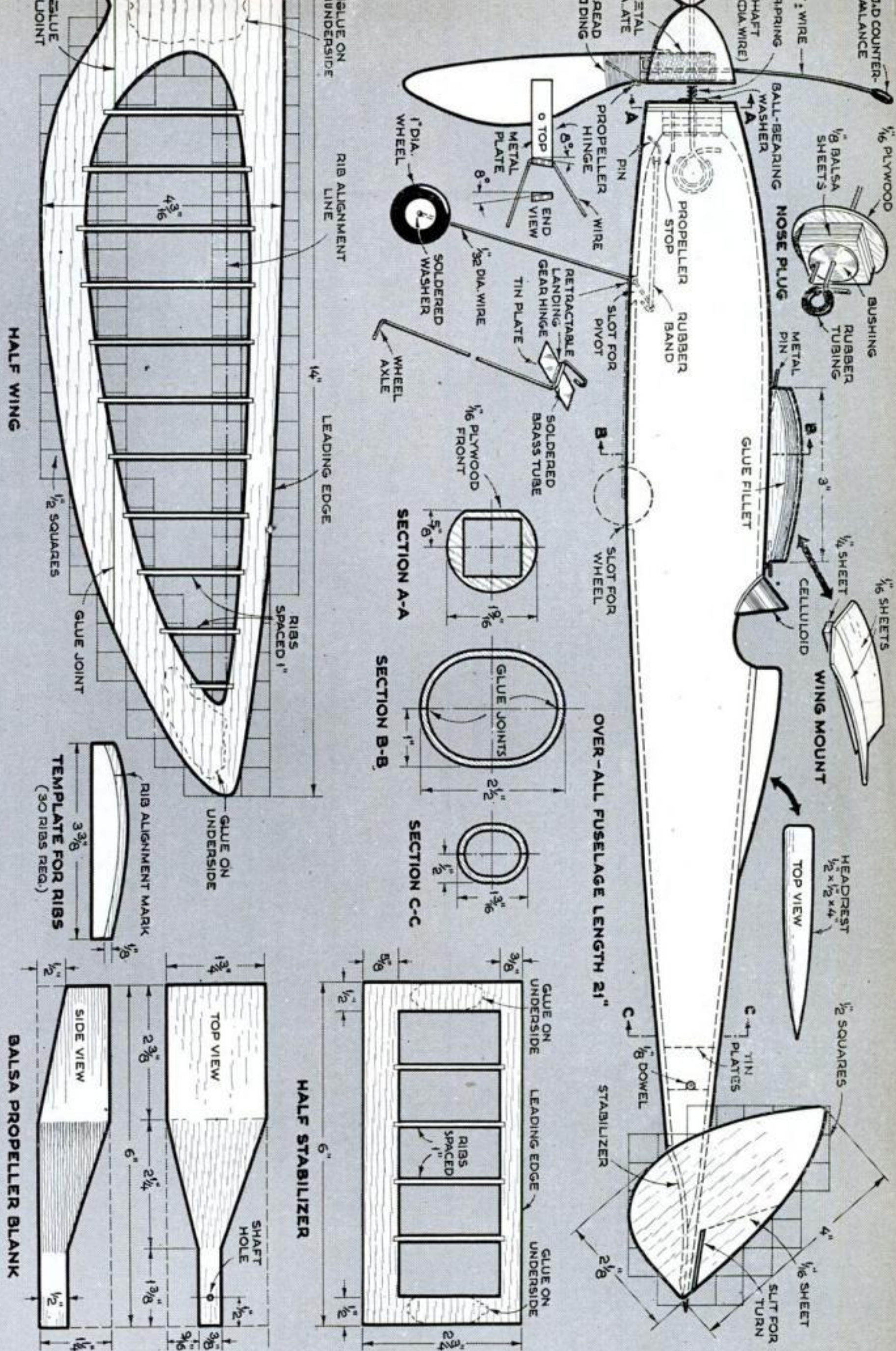
Attach the landing gear inside the right half of the fuselage with a small hinge cemented in place. Up in the lower part of the nose, cement a bent pin far enough away to keep the retracting rubber band taut when the landing gear has been drawn up. To reinforce the balsa where the ⅛" dowel motor anchor runs through, cement inside the hull two plates cut from tin-can stock and notched around the dowel.

When these parts have dried, glue the fuselage halves together. Add the headrest, wing mount, and 1/16" plywood nose facing. Let these dry, and then finish with fine sandpaper and wood filler.

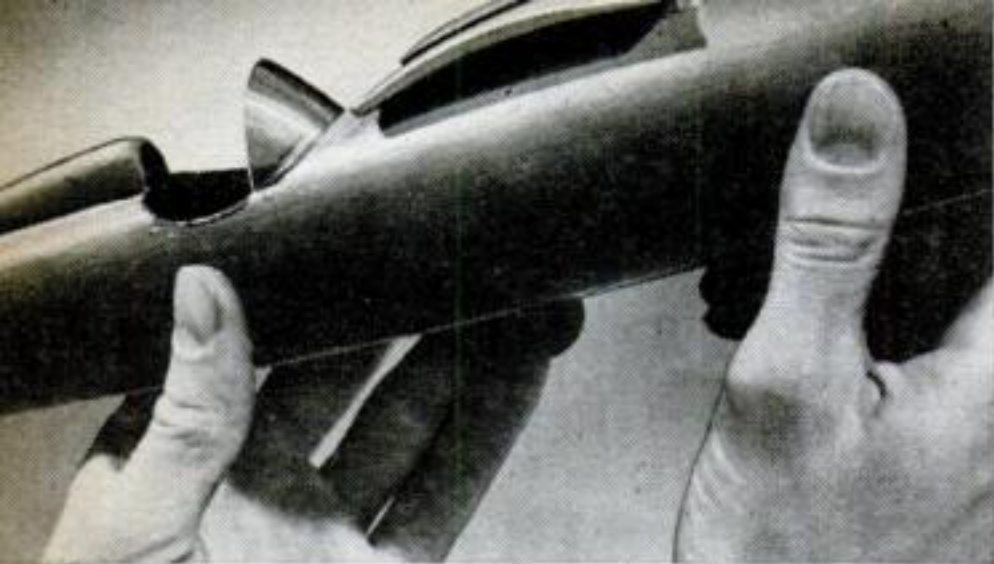
The propeller is carved from a blank to a thin airfoil shape with ⅛" undercamber. A metal plate is then cemented to the front of the propeller hub, and the spinner is carved to take the hub assembly. Give the propeller and spinner several coats of clear dope, and when the parts are dry cut the propeller blade cleanly from the hub.

Bind the wire hinge on with thread at an angle that will allow the blade to fold back against the flattened side of the fuselage, which fairs into the curve about 1" behind the nose. Press the counterbalance wire through a drilled hole in the hub, clinch it at the hinge, and balance with the propeller

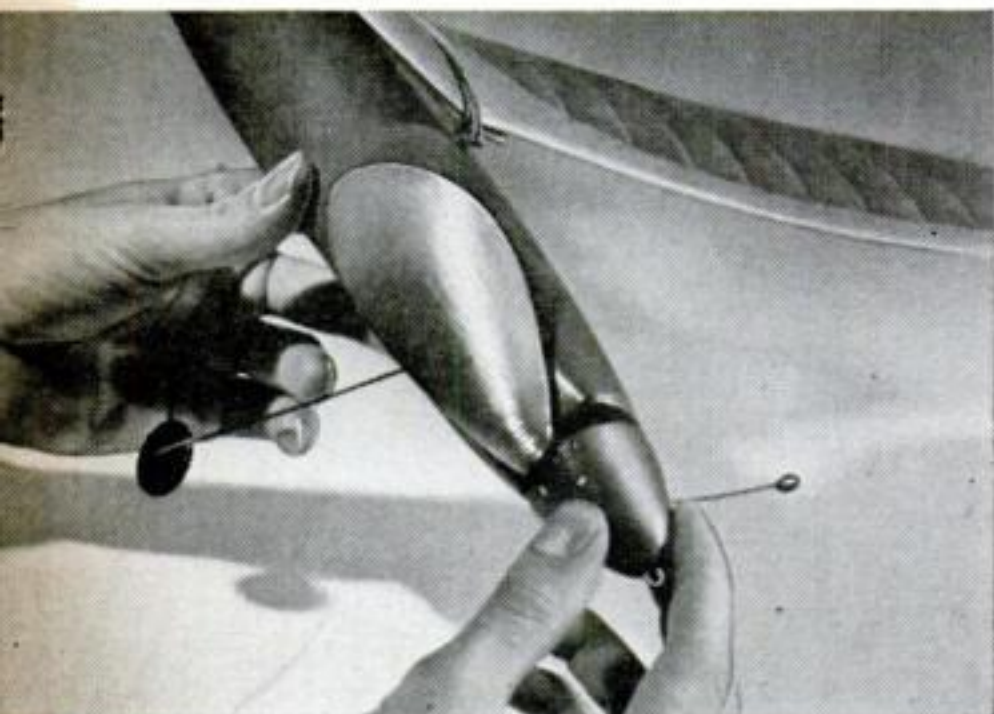




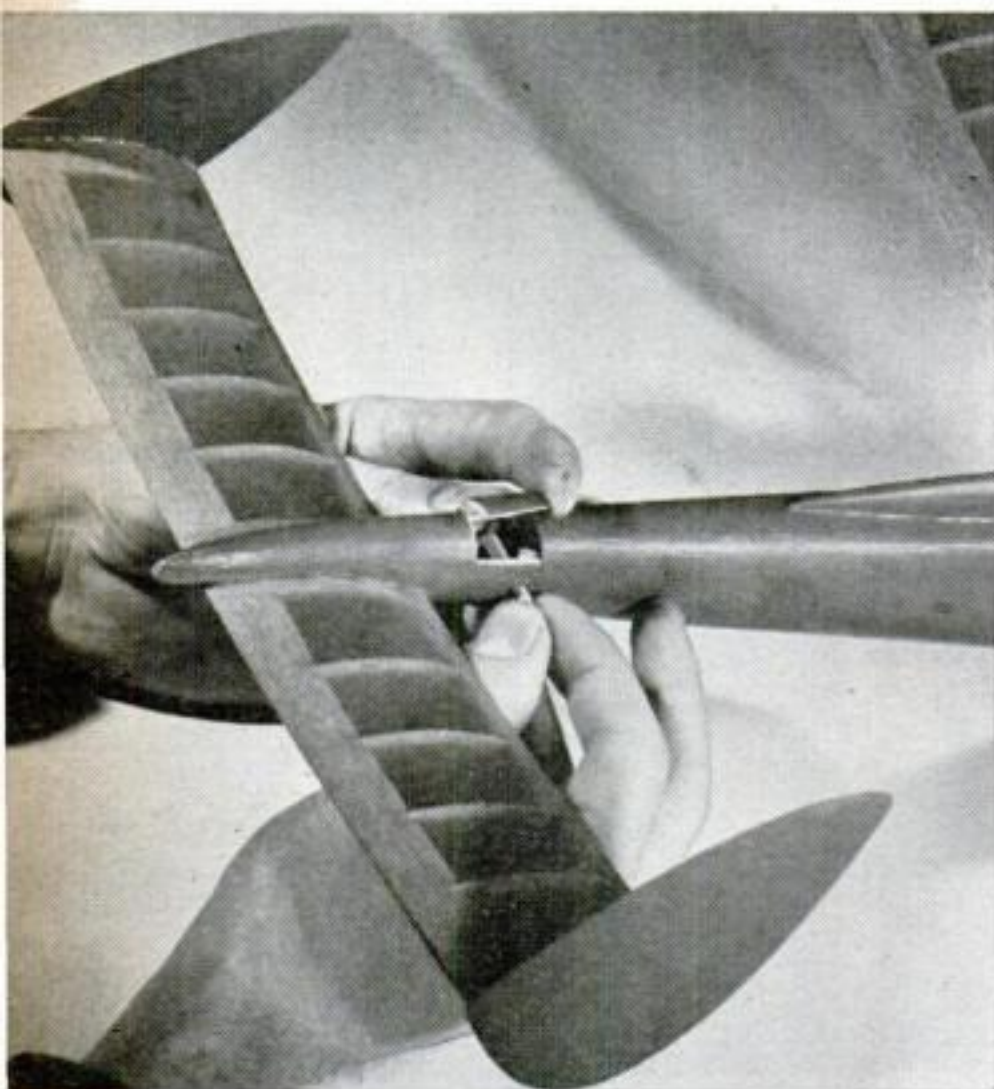




After completion of the fuselage, the wing mount, windshield, and headrest are cemented to the top.



The single propeller blade is hinged to fold back on the fuselage and lessen drag during the glide.



Rubber strands powering the model are anchored in the tail on a dowel. Note the stabilizer camber.

by removing lead from an oversize piece soldered at the outboard end.

Then put a 1/16" wire shaft through the spinner, the hub, and the nose plug. This plug is glued up from three pieces of 1/8" sheet balsa, a faceplate of 1/16" plywood, and a metal bushing. Separate the spinner and nose plug with a washer and spring. A wire stop is inserted in the plug to halt the propeller at the position where it will fold back automatically on the flat. The spring pulls the rubber hook against the stop while a turn or two remains, so the twist of the motor keeps the blade on the flat.

Cut both wings as a single piece from butt-glued 1/8" sheet balsa, and notch to receive the ribs. Dab cement on the underside at the ends and center to produce camber as the cement dries and draws the wood.

The ribs are marked on a single balsa sheet 1/16" thick and 3 3/4" wide by moving a cardboard or tin template down 1/8" for each succeeding rib. Rule an alignment line 1/2" from one edge to show on each rib. Align these marks with a similar alignment line on the wings, cutting individual ribs to required length as they are glued in. The same template, shortened to 1 15/16", is used for the stabilizer ribs. Since the stabilizer sides are square, no line is needed.

Cut the wings apart at the center, bevel the cut edges for 2" dihedral under each tip, and glue back together. Cover the bottom when dry and then the top, making sure the tissue touches every part of the rib edges. Doping provides the elliptical dihedral. Except for cutting through at the center, the stabilizer is made the same way. It is also 1/8" sheet balsa.

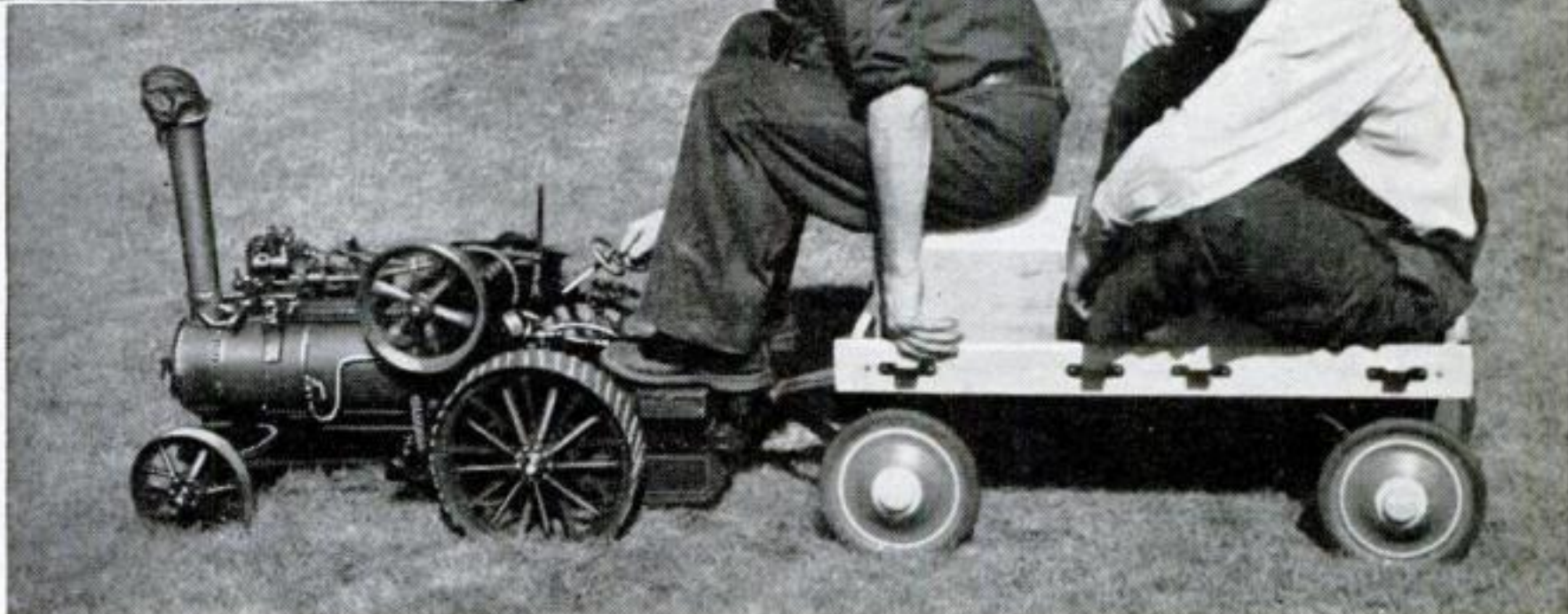
The rudders are cut and sanded to shape from 1/16" balsa, and one is slit to make the plane turn in flight. Apply a few coats of clear dope, cement rudders to the stabilizer, and then cement the stabilizer to the fuselage, giving it a slight negative incidence. Fit the wings to the wing mount, and hold them with rubber bands.

To fly the model, use about 12 strands of 1/8" flat rubber with 4" of slack. Lubricate the rubber before mounting it in the fuselage. Try the plane first for a slow, flat glide. If all works well, give the propeller a few turns, watch for any bad characteristics, and adjust as necessary. Continue increasing the turns until you reach the maximum, and then go into your powered flights and long chases.

END



## CRAFTSMEN at WORK

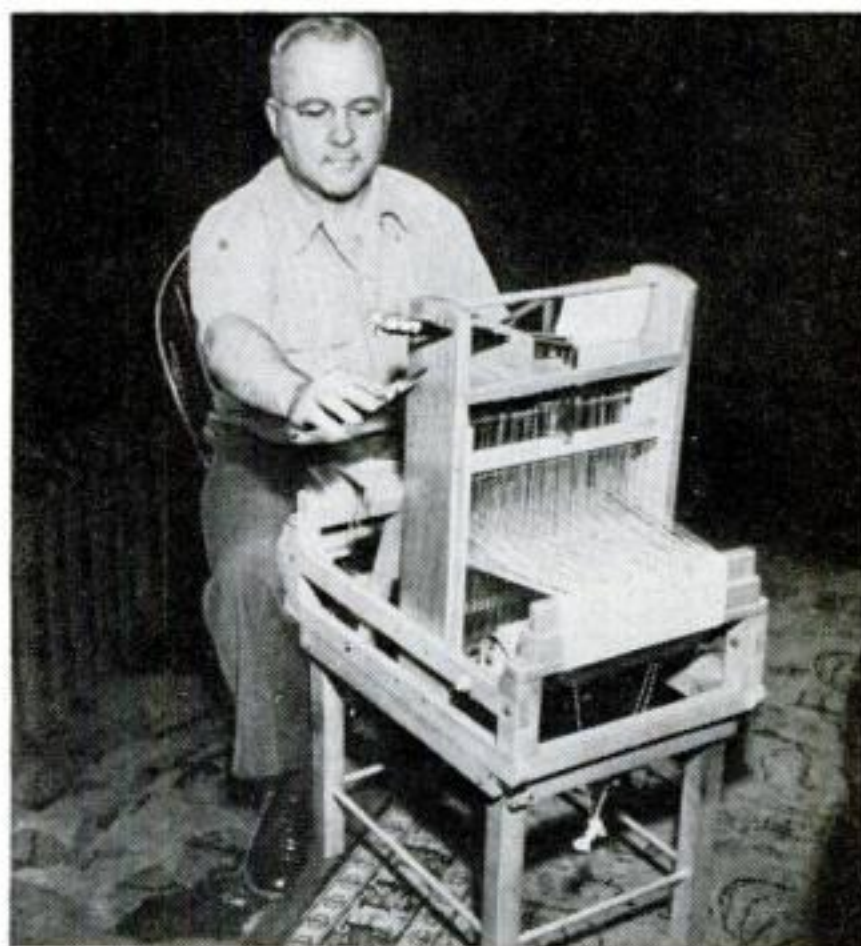
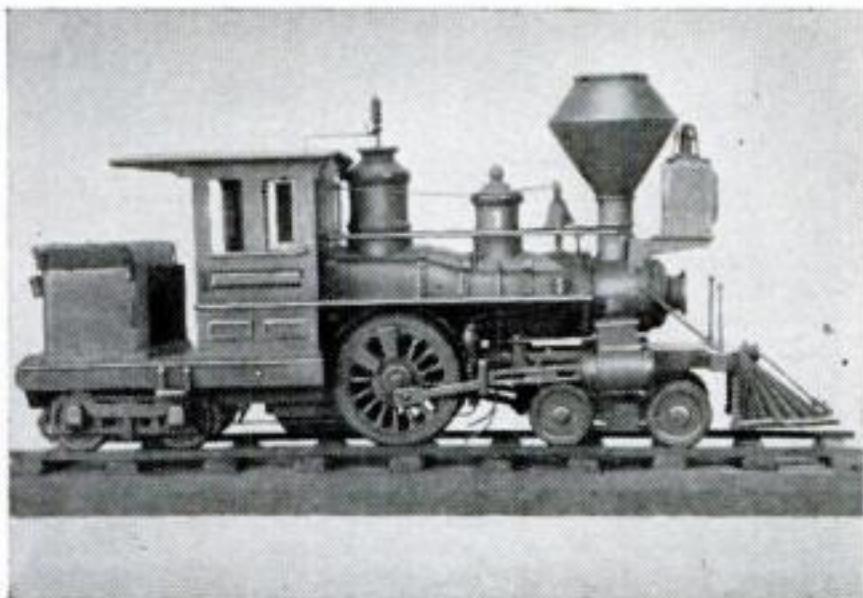


**STEAM TRACTOR.** With much noise, heat, and smell, this 1½" scale coal-fired traction engine easily hauls its builder John Matthews (in front) and Charles A. Purinton, both of Chicago, across rough turf. Photographed at a meet of the New England Live Steamers,

the little steam tractor works at about 100 lb. pressure. Its single-cylinder engine drives a rear wheel through a two-speed gear reduction and a further chain-drive reduction. A spark arrester on the stack keeps cinders out of the engineer's eyes.

**SIDEWALK SAILBOAT.** As a Scout project, Johnny Roberts, 12, of Detroit, built a dry-land sailboat. On wheels instead of runners, it rides the breezes of Lake Erie on the sidewalks of Detroit.

**SWEETHEART OF THE ESPEE.** Plans of the Southern Pacific's first engine, the C. P. Huntington (PSM, Sept. '46, p. 149) so appealed to Herbert F. Trostle, of Bridgeton, N. J., that he got busy. Below is his wooden model of the famous iron horse.



**HOBBY TURNED BUSINESS.** Because Charles Bolleter, of Linden, N. J., enjoys building hand looms, he sells his handiwork to home weavers. Above is a four-heddle model of 14" width capacity. Made in two weeks of spare-time work, it'll sell for \$30.



## KEEPING the HOME SHIPSHAPE



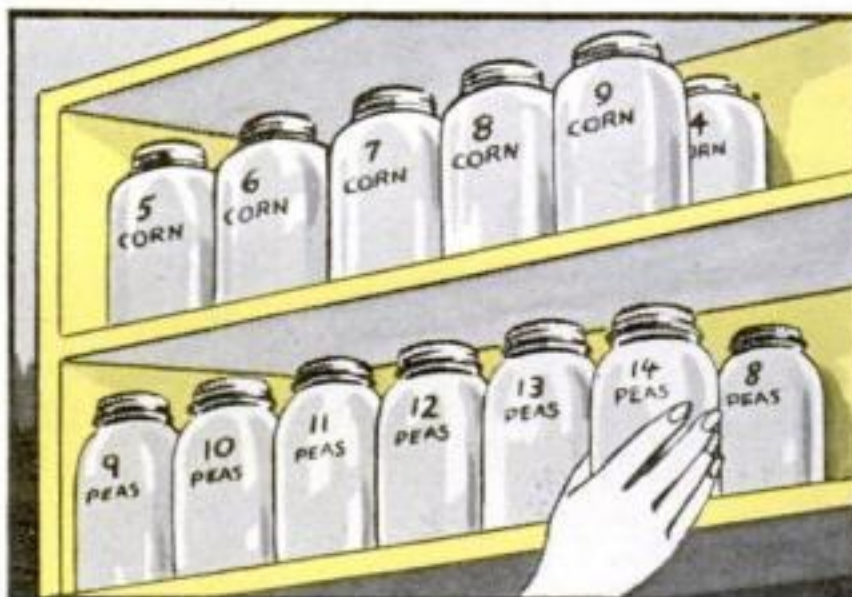
Because the minerals or chemicals in ordinary tap water will sometimes cause corrosion, makers of steam irons recommend the use of distilled water with their irons. Water obtained when a refrigerator is defrosted is pure enough for the purpose.

A double electrical outlet attached to some easily reached part of the breakfast table makes it unnecessary to bend or stretch when you want to use an appliance at the table. The outlet plate can be painted to harmonize with the table or kitchen.



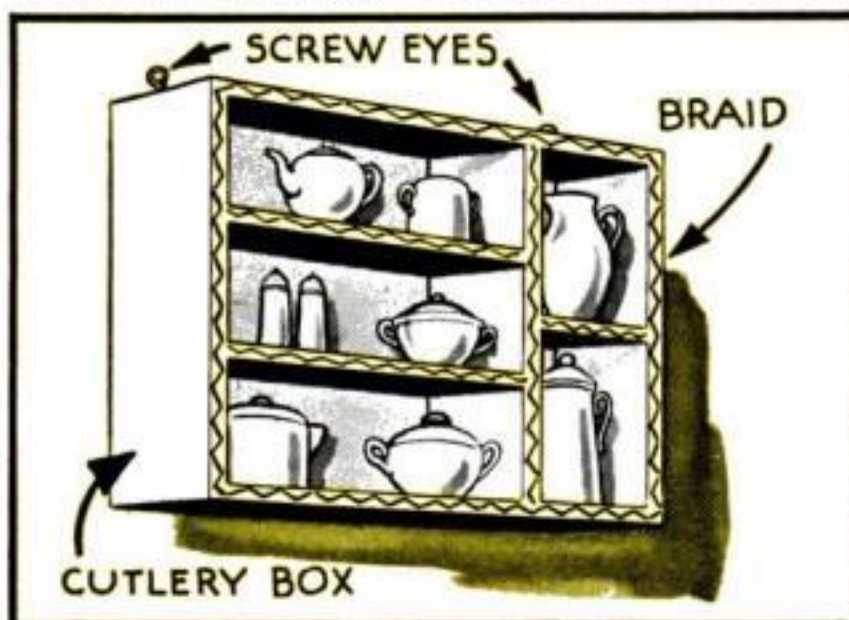
HANDLE OF TEASPOON

Want to peel an orange without spattering the pulp or juice? Dig the heel of a paring-knife blade into the skin and draw it backward around the middle of the orange. Then insert a smooth teaspoon handle into the cut and work it around until you've pried the peel loose. Remove one half, then the other.



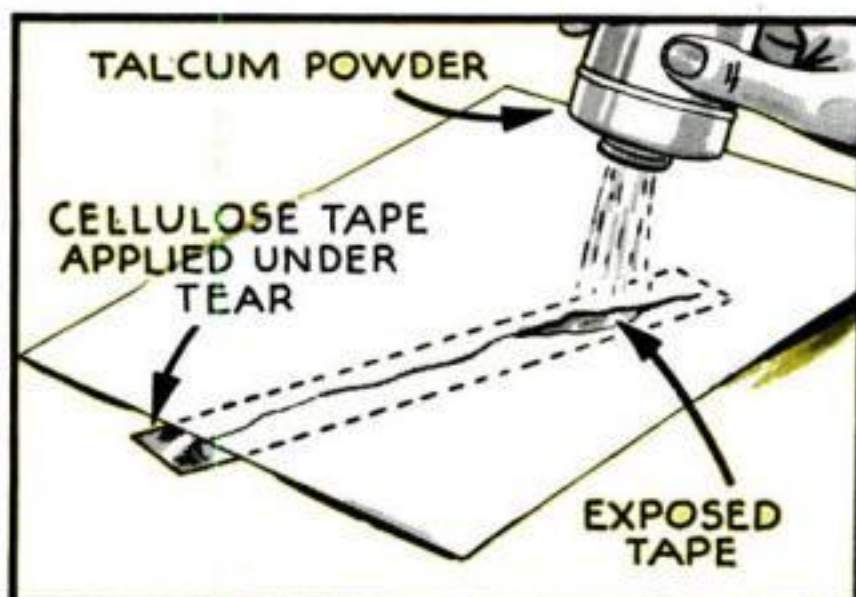
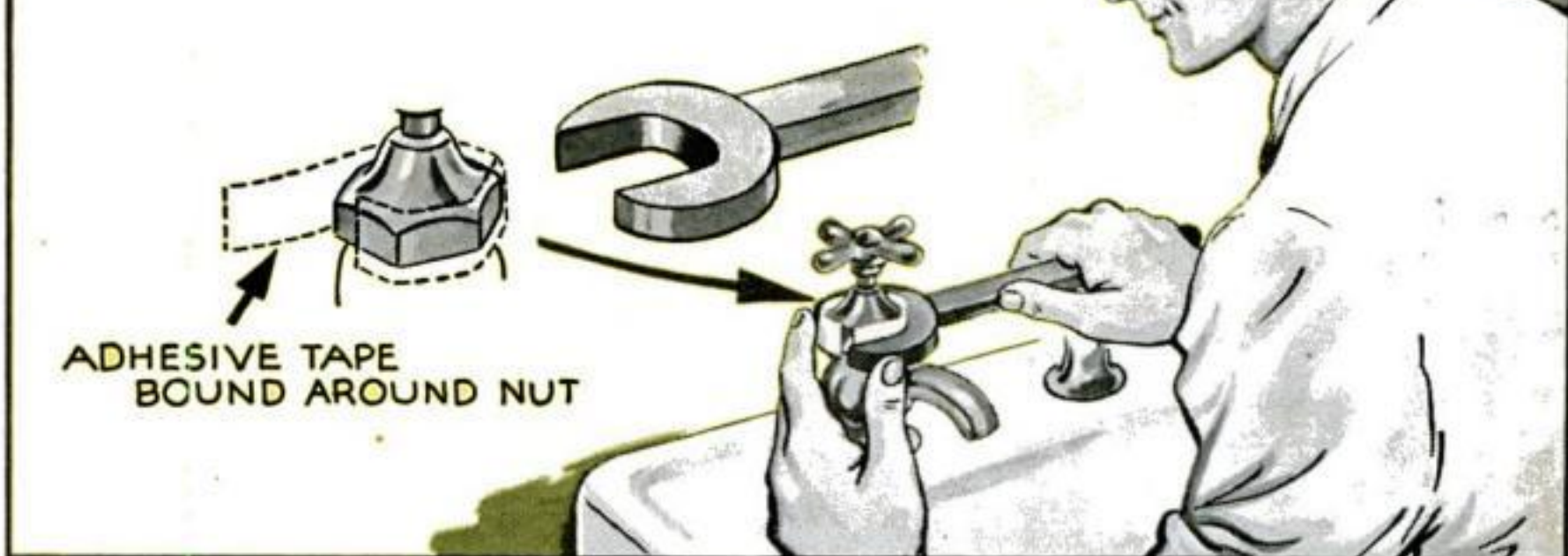
You will always know how many jars of each kind of home-canned food you have left if you number the containers and then use up the stock from the high number down. Use label stickers or write directly on the glass or metal with a china-marking pencil. When adding new jars, renumber those that are left.

A whatnot shelf for decorative miniatures can be made from a wooden cutlery box as shown below. Add an extra separation to the end tray, paint the box, and trim the edges with decorative braid or tape. The box may be suspended from screw eyes.



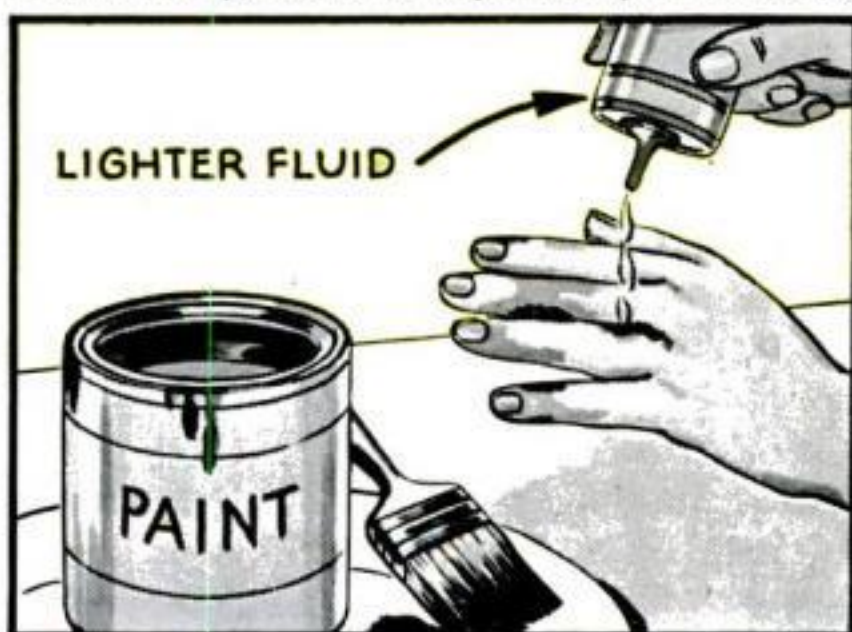


When you must use a wrench on a plated plumbing fixture, wrap a strip of adhesive tape around the polished metal to avoid scratching the surface. Also tape other points that are liable to be accidentally scratched by slipping tools.



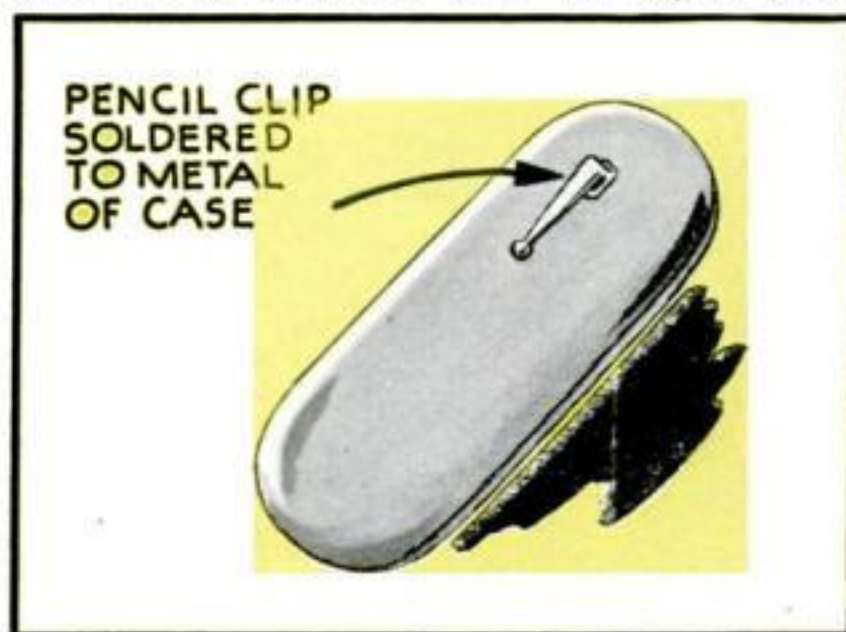
Transparent cellulose tape used to mend torn pages leaves a sticky residue at the edges and wherever any part of the tape is exposed through a tear. To prevent a mended page from sticking to others, rub some flour or talcum powder over it. Exposed parts may also be covered with tape facing the other way.

After completing a painting job you may discover that you've run out of turpentine or other thinner with which to remove paint from your hands. A few drops of cleaning or lighter fluid will quickly remove the spots and save you a trip to the store.



Do summer breezes blow the paper around when you type? A rubber-band and paper-clip holder, above, will solve the problem. Add clips until the length of the holder is great enough to secure the paper but too short to reach the roller. It will then slide off automatically when the paper moves up.

That eyeglass case that keeps falling out of your breast pocket when you bend down will stay put if it is clipped to your pocket. Flatten the top of a pencil clip, scrape through the cloth or leather cover of the case, and solder the clip in place.





**FIZZ QUIZ.** What to do when my party ran dry for want of soda water didn't stump me long. I used dry ice and a pressure cooker to wet it again. After making sure the valve of the cooker was working, I filled it with water, added dry ice, and put the lid on. Result: a pot full of ice-cold carbonated water in a flash.—DUANE F. BURDICK.



## WHAT'S YOUR INGENUITY QUOTIENT?

**IQ**



**I'M NO OCTOPUS.** So when the choke cable broke, I couldn't cover the carburetor air intake and press the starter too. An old shirt saved me. With one sleeve in the carburetor and the other through the window, I started the engine, yanked the sleeve, and was off.—WILLIAM SNYDER.

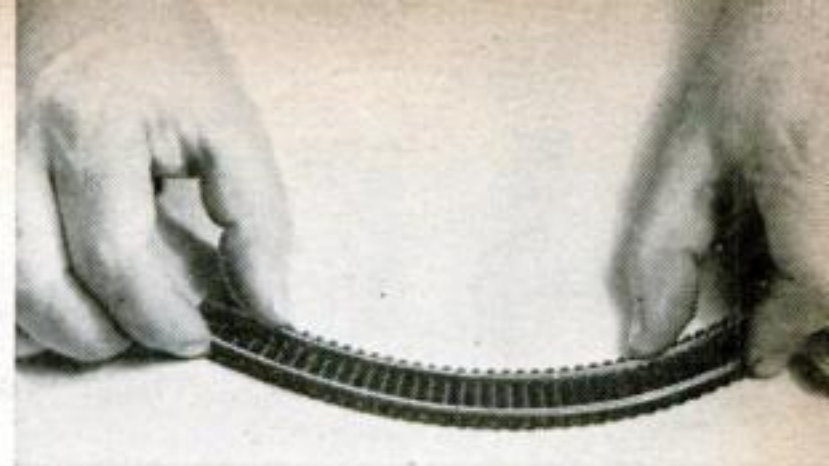
**IT MADE ME SORE** to saw a stack of logs by hand, but I soon saw a way to cut my work. A block bolted to my car's rear-wheel hub drives a wooden pitman to which the saw is clamped. The three other wheels are firmly chocked fore and aft to keep the bus from cutting loose.—C. F. CHAPTER.



Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky — if it works.

**A DRILL PRESS NAMED JOHN.** Drilling iron plate was a boring job demanding lots of muscle, until I hinged a board to the wall and put my brace under it. My son presses the seat of his pants against the board, I turn the brace, and the weighted bit makes the chips fly.—V. GAUTHIES.

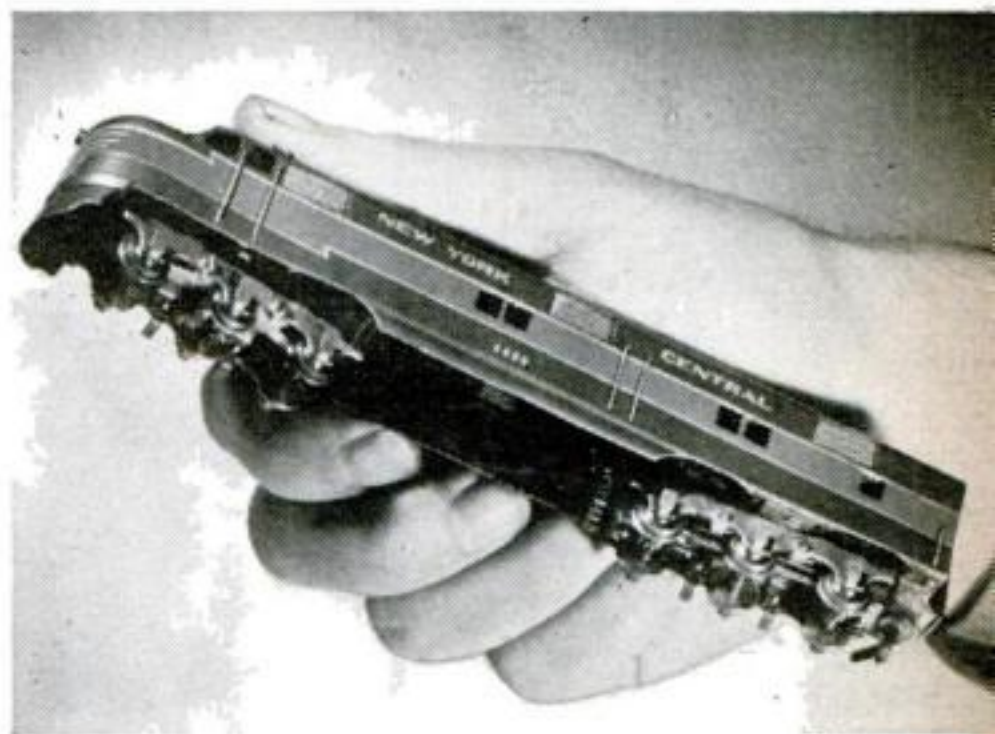




At left, the components of a TT set. The locomotive is driven by a 12-volt D.C. motor, and runs on either dry batteries or the midget power pack shown. Above, plastic tie strip being bent to shape.

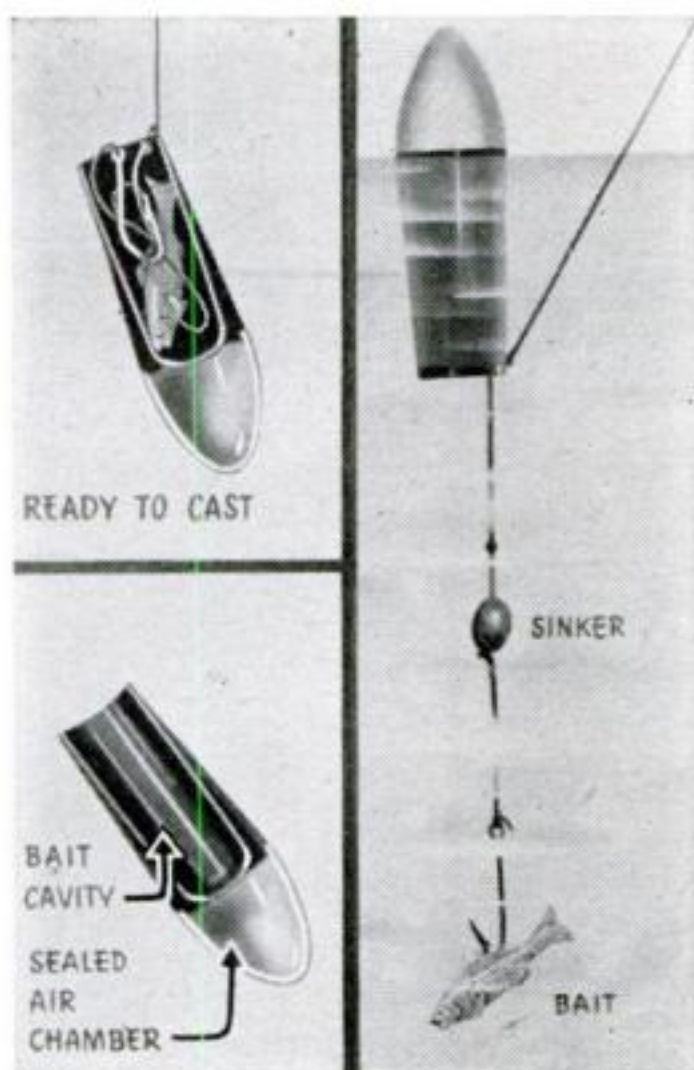
## Table-Top Trains Are Scaled from Actual Rolling Stock

SCALE versions of engines and cars in use on American railroads, these tiny trains are one third smaller than HO gauge. Tracks measure  $15/32$ " from rail to rail. The equipment, known as TT (table-top) gauge, is manufactured in kits and sets by H. P. Products Co., of Hartford City, Ind. An apartment-dwelling hobbyist can now make semi-permanent layouts without crowding himself out of his house. Molded tie strips about 9" long are cemented to a firm base and can be bent to any radius over 18". Track, which comes in 21' lengths, is pressed into grooves that are preformed in the ties.



Relative size as well as the intricate detail of these trains may be judged from the photo above. A variety of models and accessories is planned.

## Float Holds Bait During Cast and Drops It to Preset Depth



LIVE-BAIT fishermen can enjoy the mobility, distance, and accuracy of plug casting by using the bait-holding float made by the Eureka Specialty Co., Inc., of Eureka, Kan. Bait placed inside the cavity in the float is protected from loss or damage during the cast. When the float hits the water, the air chamber in the nose rights it automatically and permits the sinker to drop the bait to any desired depth.

## Crossed-Wire Sight Fits Revolvers

QUICKER and more instinctive sight alignment is offered to pistol marksmen by Dockendorff & Company, of Oronoque, Conn., makers of a new crossed-wire gun sight that can be clamped to the front of any revolver barrel. The wires are easily adjusted to intersect the top and center of the front barrel sight. Price is about \$4.



The 1-oz. sight is  $2\frac{1}{4}$ " high and  $1\frac{1}{8}$ " wide.



# Jigsawed Pieces Build 100 Animals

By **HI SIBLEY**

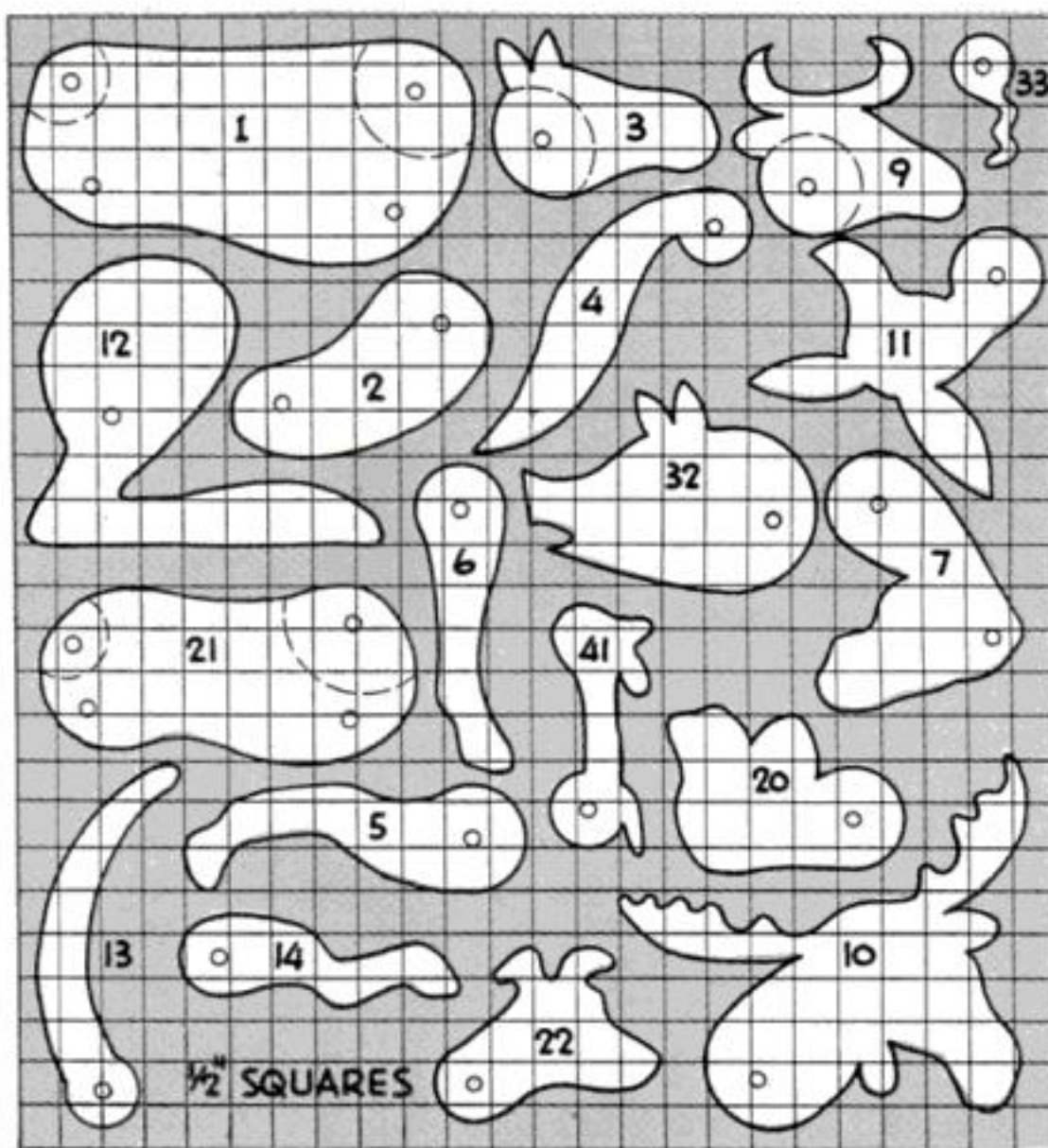
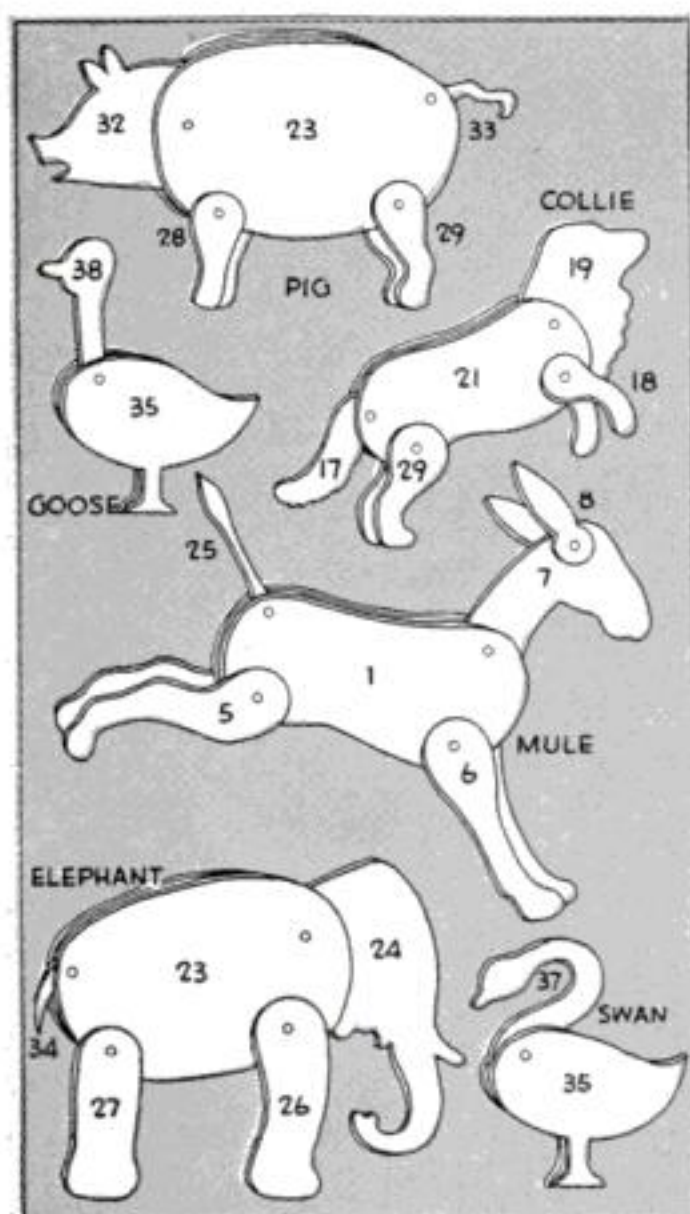
**F**ARM and circus animals—a complete assortment of them—can be built by a child from the 41 jigsawed parts below. The pieces are cut from  $\frac{1}{8}$ " plywood, or such solid stock as cigar-box wood, and are bolted together, either somewhat loosely so the joints will move or tight with the parts in fixed position.

A typical assembly is shown in Fig. 1. The body is glued up as a sandwich, the center "filling" having cutouts to receive the head and tail. Legs are put on the outside, as in Fig. 2. If knurled nuts are available for the  $\frac{1}{8}$ " machine screws, washers and a small wrench will not be needed. Sand the joints of necks and tails so they can be slipped easily into their sockets.

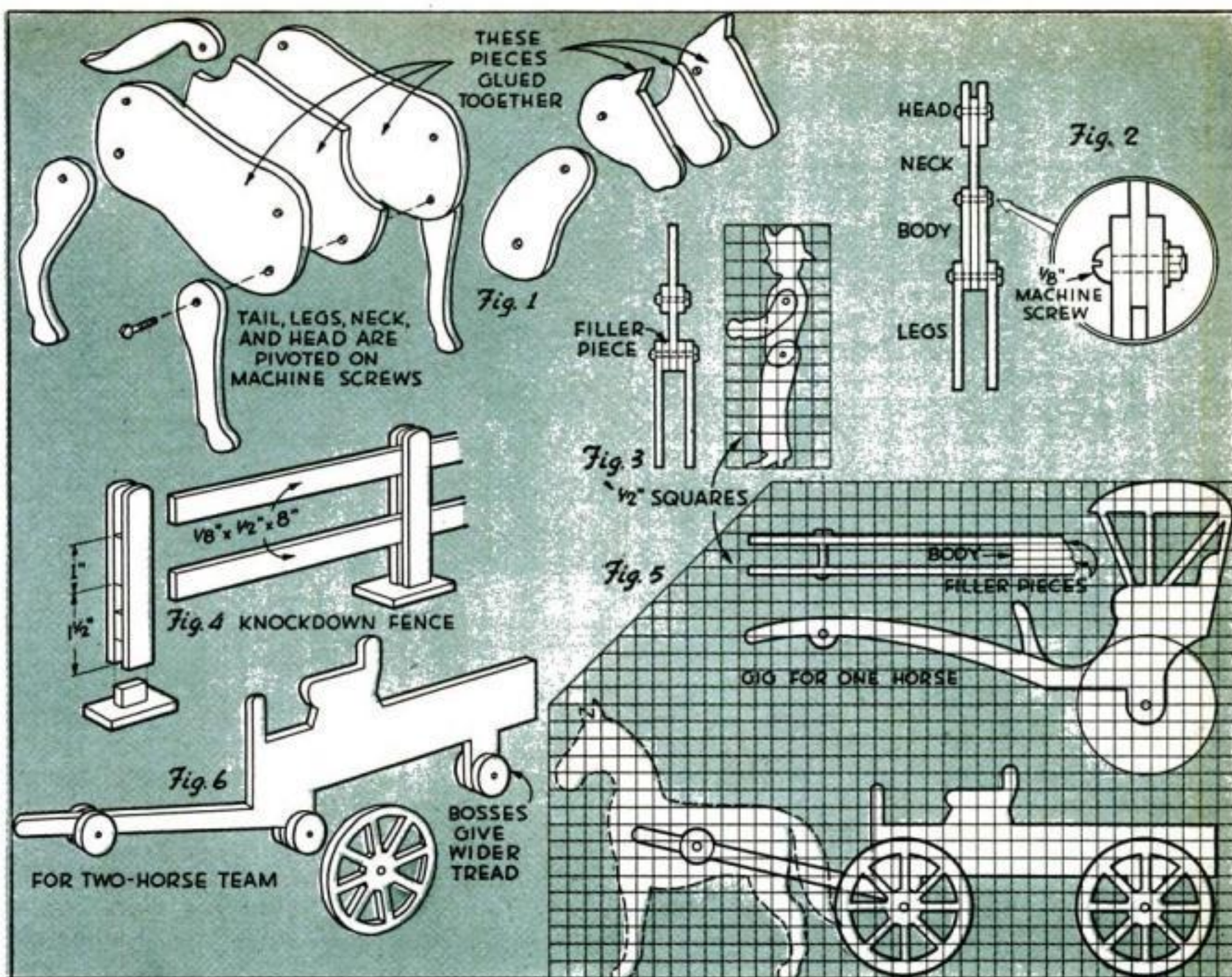
The man shown in Fig. 3 is constructed with legs spaced wide enough apart to straddle the horse. Posts for the fence (Fig. 4) are glued up, and the rails are simply set in the sockets with the joints meeting at the middle. The farm wagon and gig shown

in Fig. 5 have wheels that turn. These are the same for both vehicles. Make the shafts of the gig far enough apart to accommodate the three-ply body of a horse. The wagon has a single tongue, as in Fig. 6, for a two-horse team bolted through from the sides. Bosses at the axles will make the tread wide enough for the vehicles to stand upright.

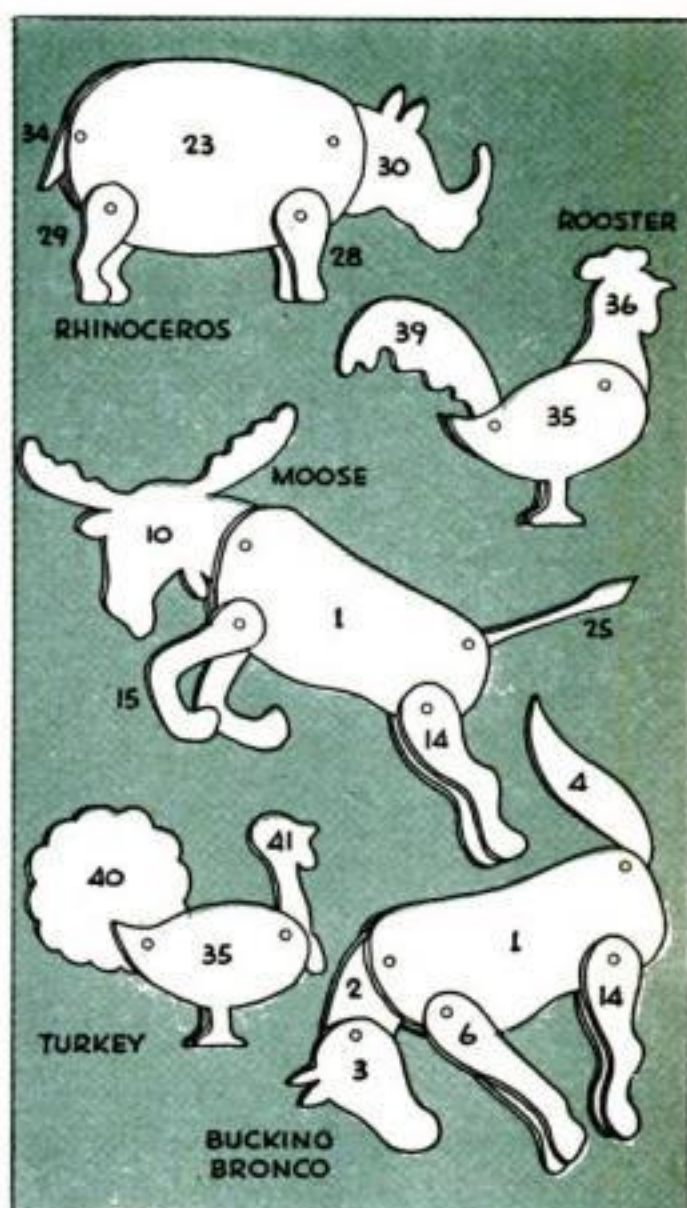
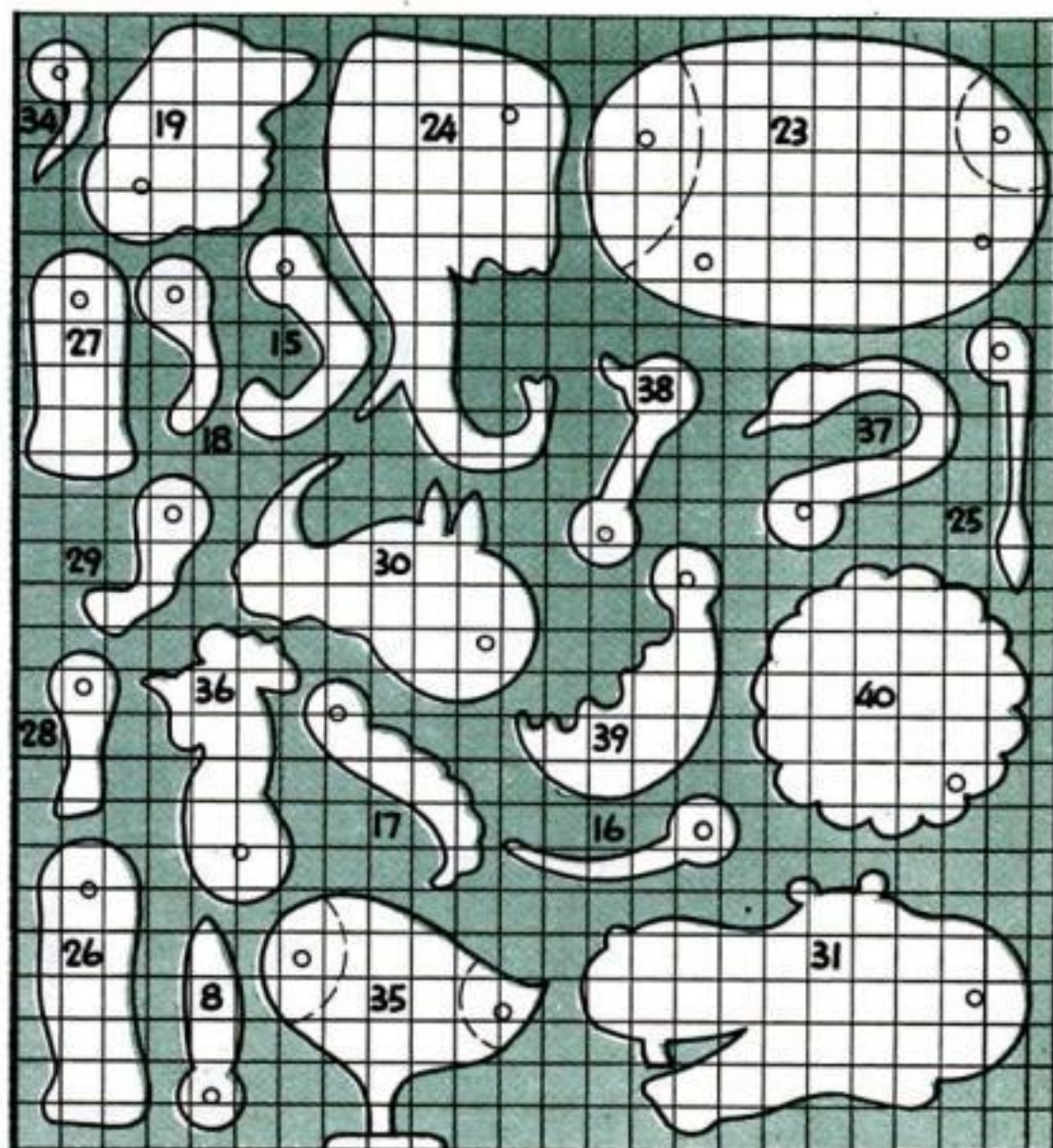
Parts for a variety of animals are shown in outline below and on the facing page. The center body section, or filler, is cut out for joints as indicated by the dotted lines. There are four main groups, each using the same body—horse, mule, cow, moose, and kangaroo; pig, elephant, hippopotamus, and rhinoceros; fowl; and dogs. Each member is numbered so the combinations can be chosen easily. Note that the cow is made by reversing the horse body end for end and using the neck upside down. So many more combinations are possible that a child will be able to make up no end of strange creatures, many of which would baffle the most learned of zoologists.







Typical construction of figures for a toy barnyard. The animals below are assembled just as the horse is.





# Car-Trunk Boat Carries Two

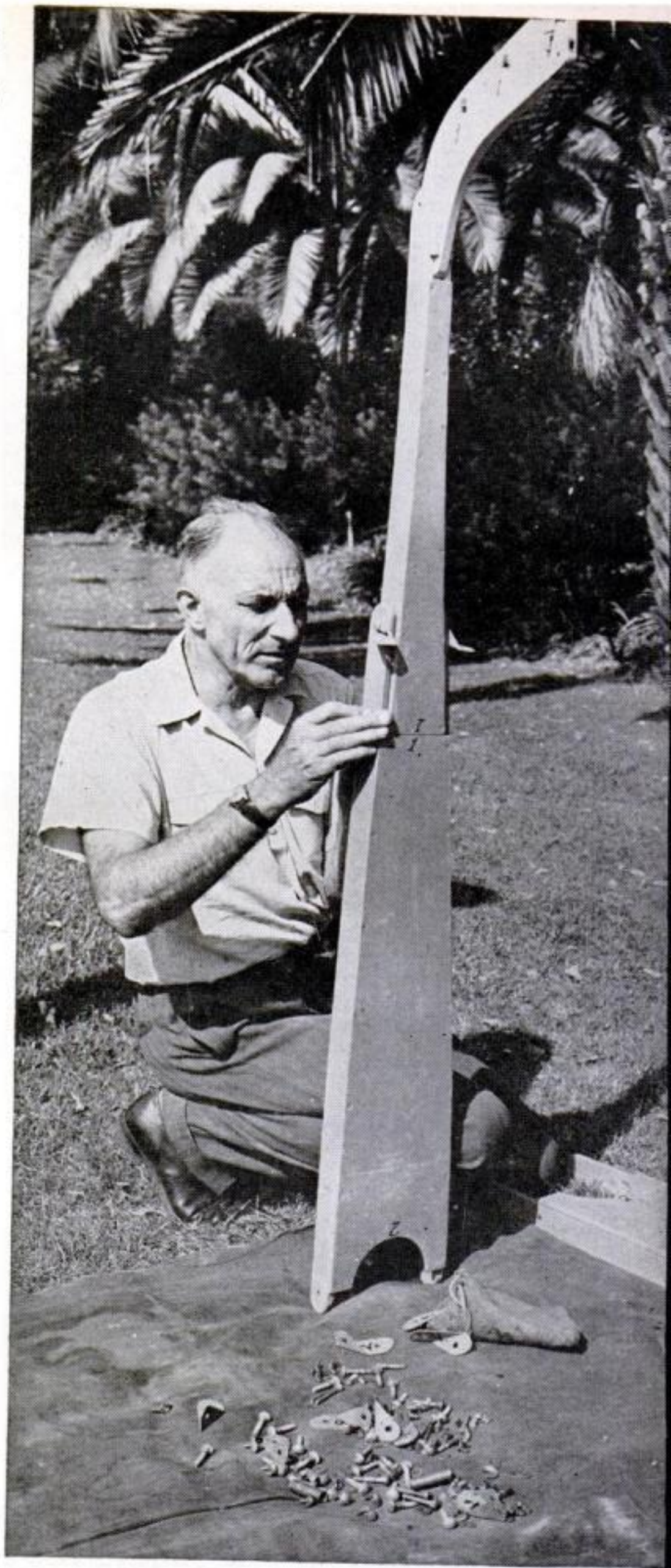


Stowed in compact packages beside the spare tire, car tools, and camping gear, this folding boat is carried easily by Professor Bauwens down to the shore. It can be assembled in 22 minutes.

CANVAS and plywood form the principal parts of this knockdown boat built by George O. Bauwens, professor of civil engineering, with the assistance of students in the shops at the University of Southern California. It is a 62-lb. craft, 17' 9" long, and is designed to be carried in the trunk of a car. The boat can be assembled in 22 minutes and taken apart again in 15. It carries two persons and, though frail in appearance, is sturdy enough for shooting rapids. To prove it, Professor Bauwens and three student companions recently negotiated 168 miles of the rapid- and whirlpool-studded Colorado River in this boat and another like it. They made the trip in 10 days without even getting their feet wet.

The boat consists of five main assemblies—a collapsible keel, bulkheads, longitudinal stringers, a waterproof-canvas covering, and gunwale. No tools are needed. Bolts fitted with wing nuts and strong cord are the only fastenings that hold it together.

180 POPULAR SCIENCE

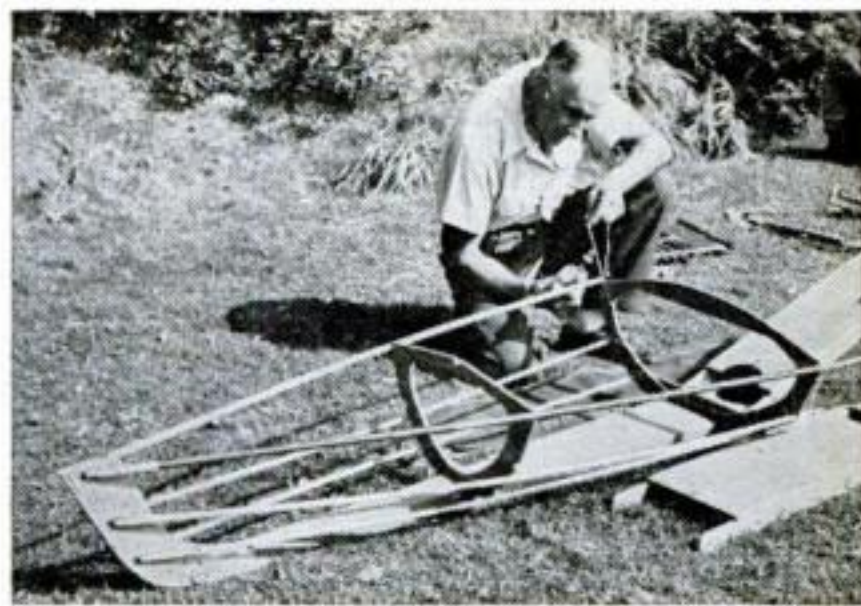


1 Two parts of the keel are bolted together here by Professor Bauwens. No tools are required since wing nuts are used. There are six parts to the keel. Joints are numbered for convenience.





**2** Bulkheads fastened in place give the framework shape and rigidity. Of  $\frac{5}{8}$ " plywood, they are light in weight without sacrificing strength. The two halves of the keel are not yet joined.



**3** Stringers are lengths of dowel rod fitted into sockets on stem and bow, slipped into notches in the bulkheads, and then simply tied on tightly with several pieces of strong cord.



**4** Waterproofed canvas forming the one-piece hull covering is next pulled on over the two ends of the frame much as a glove is put on the hand. The ends are pushed in as far as possible.

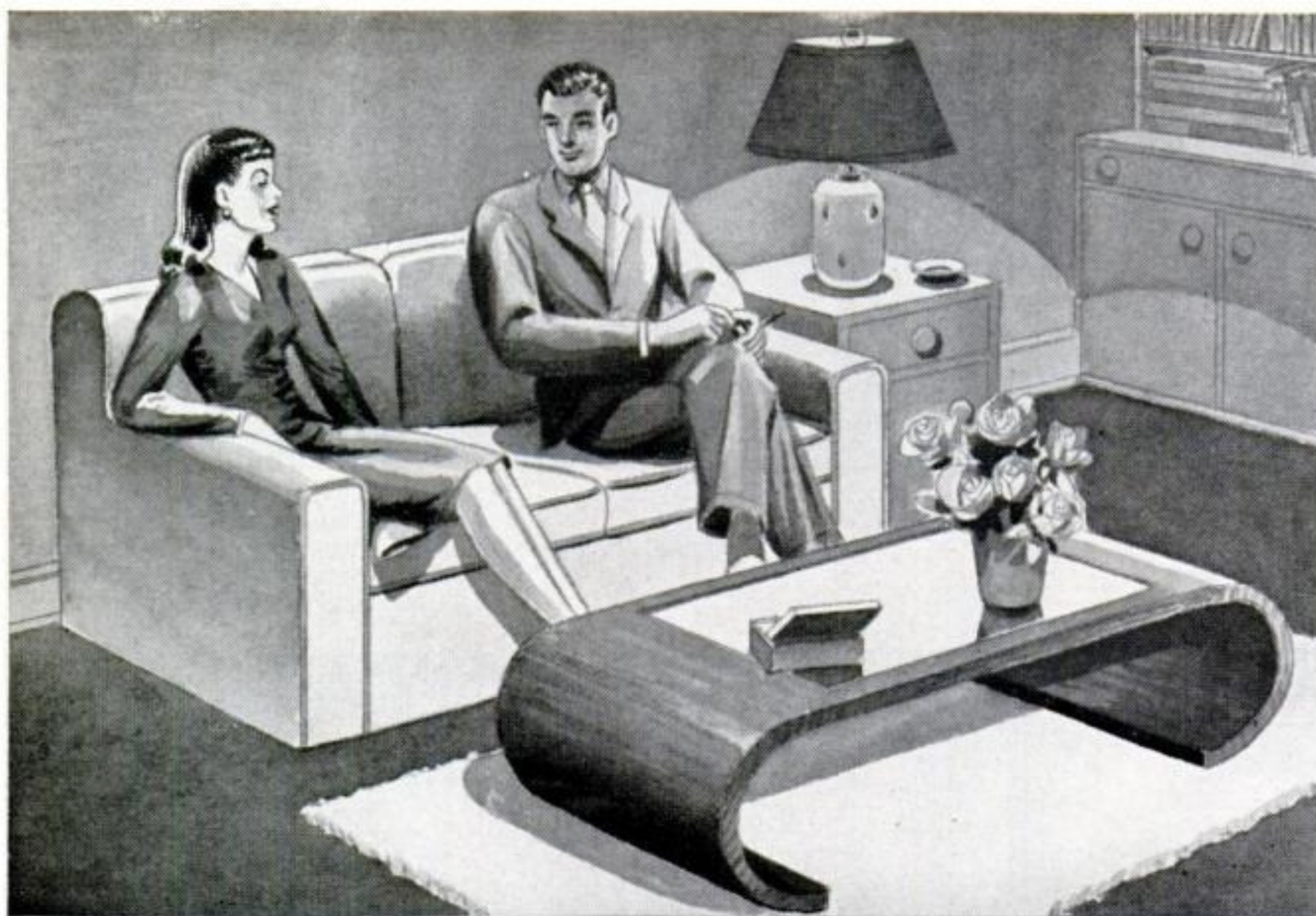


**5** Then the keel is bolted at center and pressed down with the foot to make the canvas taut and the keel stiff and straight. This action is like that of a shoe tree pressed into a shoe.



**6** Two men can be carried by the boat, and one man can carry it. Complete with gunwale attached, seats installed, and two double-ended paddles, the boat weighs only 62 lb. It is 17' 9" long. With three companions in this and another boat like it, Professor Bauwens recently shot the rapids and negotiated the whirlpools of the treacherous Colorado River, covering 168 miles in 10 days.





# Veneered Table Uses Little Wood

**By Edward E. Thorp**

**V**ENEERING is always a fascinating art to the craftsman who works with wood. This project provides the additional interest of gluing veneer sheets to both convex and concave surfaces. The end result is a satisfyingly handsome coffee table that will fit in well with any modern furniture.

Structurally the table is simply a frame to hold a clear-glass or mirror top and a framework on which to glue the veneer. Any clear glass used should be preferably of double thickness, and a  $\frac{3}{32}$ " allowance for clearance must be made in the frame. If a suitable piece of glass is on hand already cut, the size of the table top may well be altered to fit. A wood panel may be used instead of glass or a mirror. Attractive contrast will be gained if it is different in color from the veneer.

If the leglike ends are laid out in quarters and eighths of a circle from a cardboard template, these parts can all be cut from  $\frac{3}{4}$ " by  $2\frac{1}{2}$ " and  $\frac{3}{4}$ " by 4" stock. Face square

and glue up so the joints will not come together. The height of the table is equal to the diameter of the outer edge of the circle and can be lowered or raised simply by changing the diameters, though 15" will be found a good medium height for most modern tables. Probably, the maximum convenient height for this table would be about 17", depending on length, while under no circumstances should it be lower than 13".

Brace the ends with  $\frac{3}{4}$ " by  $1\frac{1}{2}$ " by  $7\frac{1}{8}$ " boards rounded slightly on the outer edge and set in even with the circular pieces to assure a good, flush surface for the veneer. Glue in triangular corner blocks at top, center, and bottom, as shown in the drawing, splitting them from straight-grained stock 1" square. Then set the frame upside down on the bench for ease in handling, and nail and glue on the bottom end strips. Try the legs with a carpenter's square to make sure they are true with the top, and clamp temporary braces on the outside from end to end to



hold the assembly square while the veneering is being done.

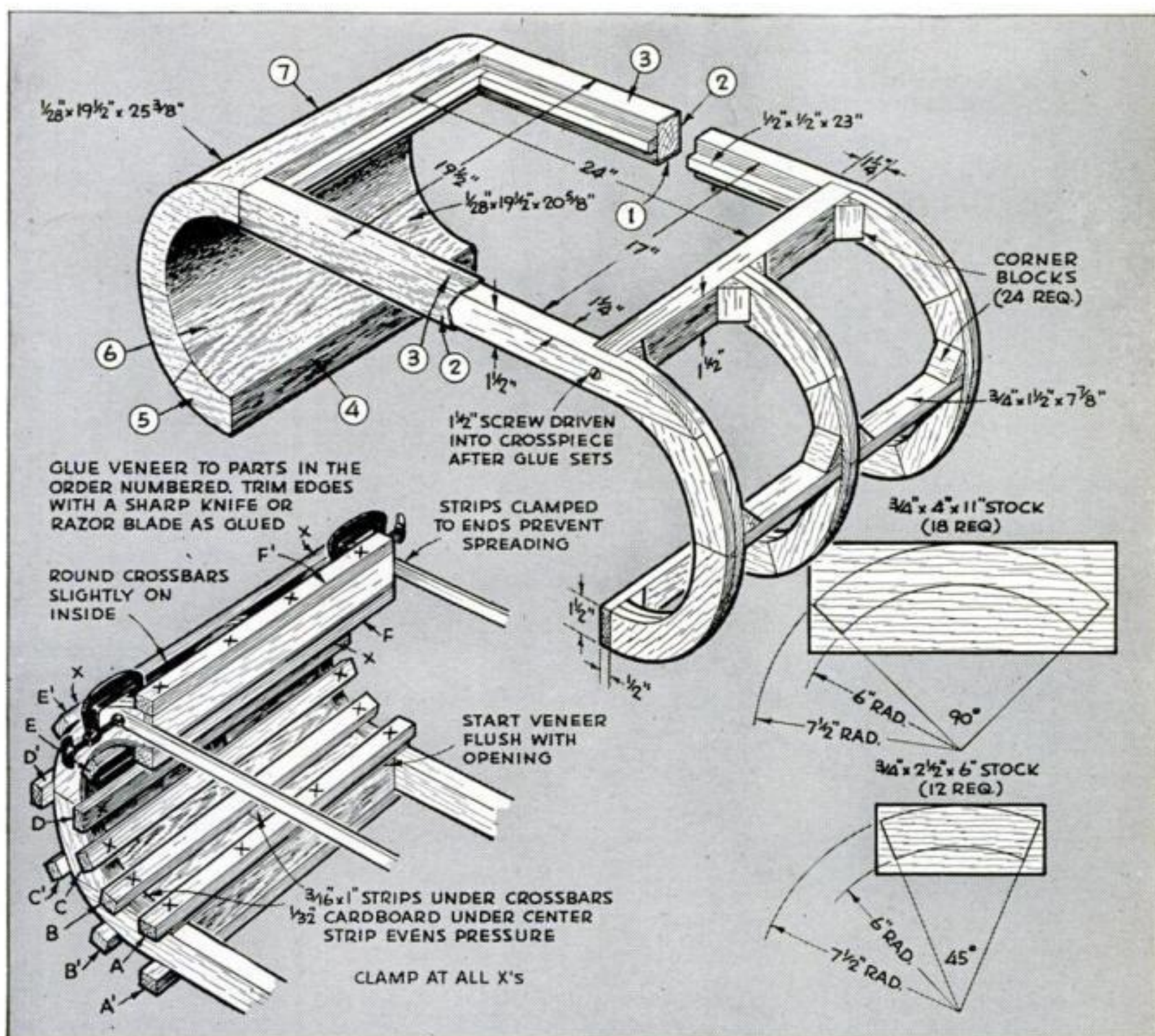
Before cutting the veneer, make cardboard templates directly from the table and use them to check the measurements, especially those of the curved end sections, which will vary considerably if the radiuses of the arcs are changed. The pieces should be cut slightly oversize and trimmed flush as each is glued on in the order shown numbered in the drawing. Standard veneer of  $1/28''$  thickness is called for, but if the ends will be required to withstand considerable bumping,  $1/16''$  veneer may be obtained.

A method of applying and clamping the veneer sheets to the inside curves is shown in one drawing. After the glue has set, the clamps and crossbars are removed, and then the veneer is applied to the outside curves in exactly the same manner. Lay the sheets to be curved flat in water overnight, and

then bend them around cylinders 12" to 14" in diameter, winding soft cord or tape loosely around them to hold them in place. They will be curved enough when thoroughly dry to go on the rounded frame.

Start the gluing by aligning one edge flush with the opening for the top of the table, place light strips at the edges and center, lay on crossbars A and A', and clamp at four or more places, as indicated by the X's. Next, clamp on crossbars B and B', and so on to the end. Be very careful not to press on any surface not supported by the frame as you work, or you will have hollows in the completed piece.

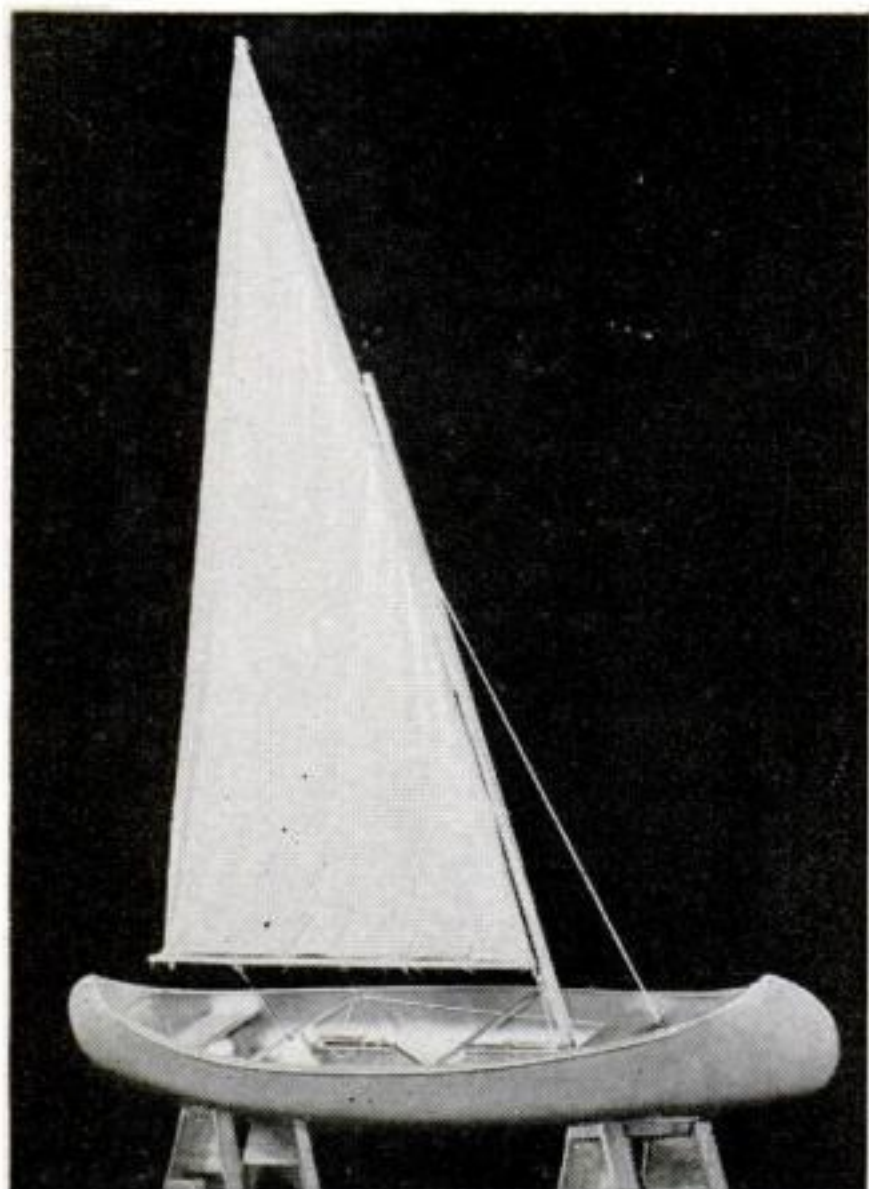
Four coats of wax, applied quite warm and rubbed in, will give a finish that not even alcohol will mar. After waxing, screw in  $1/2''$  by  $1/2''$  strips to support the glass flush with the top surface. They should not be waxed, since this would cause spotting.



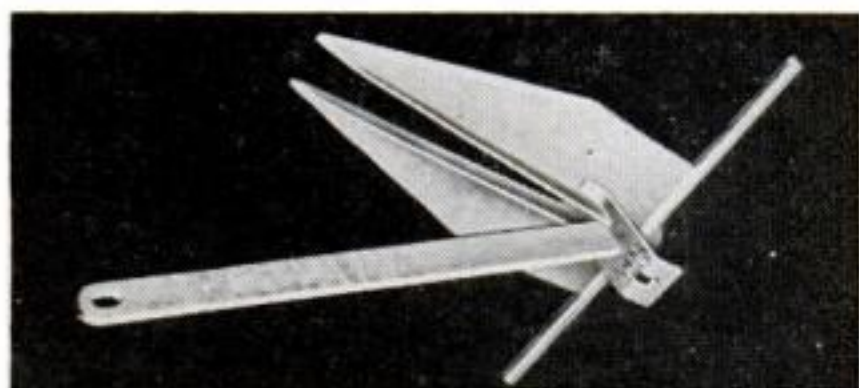
Legs are glued up from sections, with staggered joints. Apply veneer to the parts in the order numbered. Clamp the curved end veneers under crossbars, as at lower left, in the order indicated by the letters.



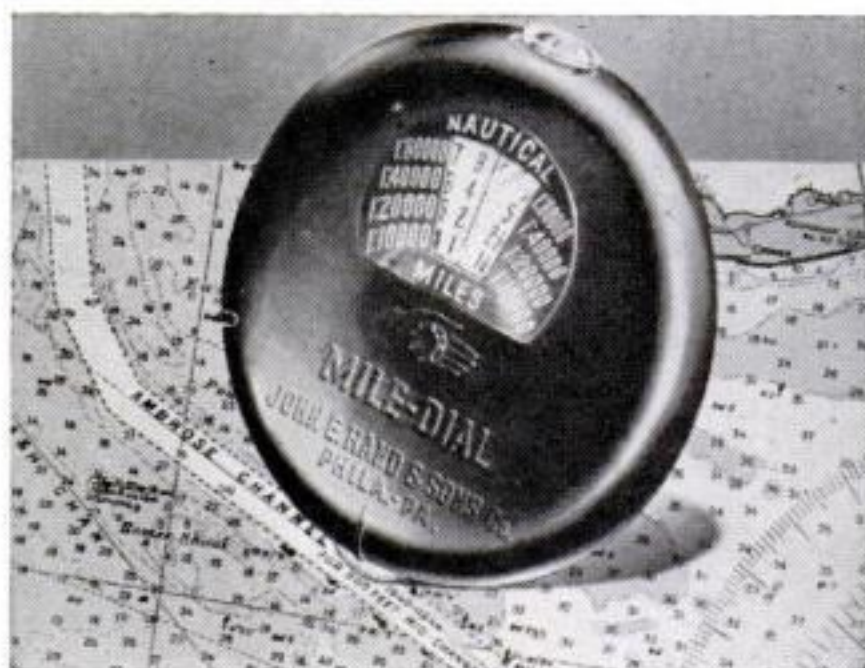
# • FOR BOATS AND BOATING •



**SAILING CANOE.** An aluminum center-board unit, with rudder and skeg assembly, gives stability to a 16' aluminum sailing canoe made by the Rice Manufacturing Company, of East Boothbay, Me. Spars consist of mast, boom, and topsail club, all made of clear pine. The sail, which has an area of 42 sq. ft., can be lowered by a person seated by the rudder. With the mast removed, the canoe may be used for paddling in the usual way.

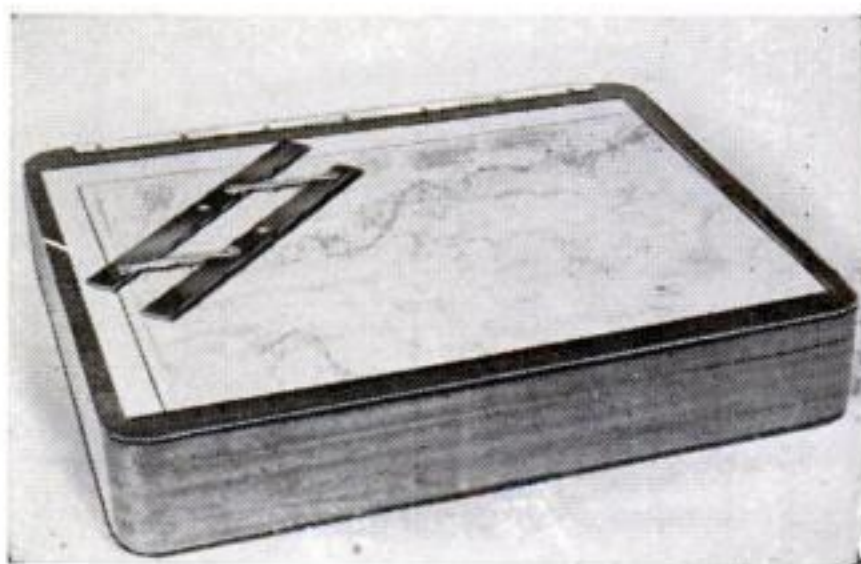


**ROWBOAT ANCHOR.** Pivoted flukes on this 4½-lb. anchor dig deeply into the bottom for a strong hold, and yet break out easily on a vertical pull. It is a product of Danforth Anchors, of Berkeley, Calif., and is priced at \$3.50.



**MILE DIAL.** An instrument manufactured by the John E. Hand & Sons Co., of Haddonfield, N. J., gives a quick measurement of the distance between two points on a marine chart. When the instrument is run over a course laid out on a chart, the dial automatically registers the distance. Available either for nautical- or statute-mile charts, it is calibrated in the four scales most commonly used. It sells for \$10.

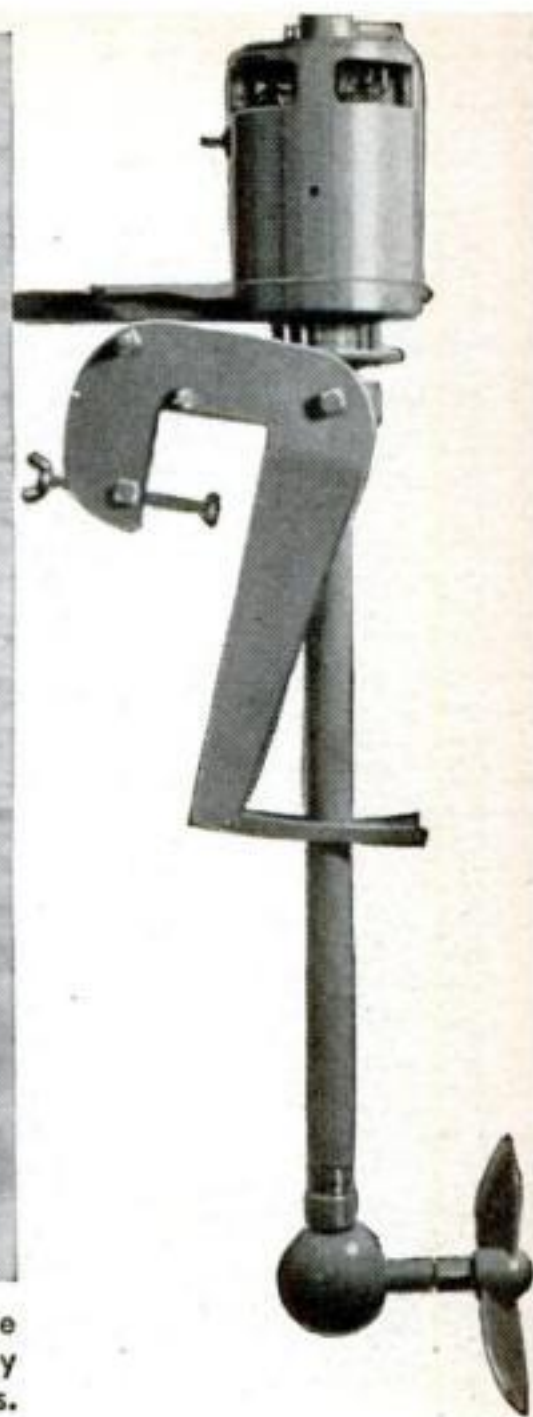
**CHART AND FRAME CASE.** Yachtsmen who travel in confined waters have to check their navigation charts frequently even though this may mean unrolling and flattening many sheets. The Navy had charts taped between flat plastic holders, and now an adaptation of the Navy method is made available to civilian sailors by the Gillis and Guthrie Mfg. Co., of Branford, Conn. In the navigation gear pictured below, flat charts and instruments are stowed inside the mahogany case. The chart being used is slipped under the matte-finish plastic shield on top. Pencil markings on the plastic are easily erased.







A single battery drives a boat at trolling speed. Two in series give more speed but a shorter run per charge. Variable speed can be obtained by detachable clips put on various cell straps to give 6, 8, 10, or 12 volts.



# Electric Outboard Stalks Fish

**By Alfred J. Brosseau**

**I**F YOU would enjoy the indolent luxury of gliding effortlessly over the water, or if you'd like to steal up on the fish in your favorite spot and troll as you go, you'll want to make this electric outboard. Powered by a three-brush generator that you can pick up at an auto wrecking yard, it will drive the average rowboat for hours on a battery charge. The unit is light and readily portable, while the battery can easily be kept in the trunk of a car. If an extra lead is run from the engine generator, this extra battery can be kept charged during ordinary operation of the car.

Since construction details will vary with the generator used, obtain it before building the rest of the unit. The generator shown is from a late Model-A Ford, but any three-brush generator can be used. The only

electrical changes necessary consist of removing the adjustable (third) brush and connecting its lead (from the field winding) directly to the insulated terminal atop the housing. The generator will now run as a motor when connected to an ordinary 6-volt battery, and should draw 10 to 12 amp.

Cut off the threaded part of the shaft. Centerdrill the end of the shaft and drill  $\frac{3}{8}$ " dia. to a depth of  $\frac{3}{4}$ ". Drill a transverse  $\frac{3}{16}$ " hole about  $\frac{3}{8}$ " from the end, and saw down to the hole with a hacksaw to form a slot. The generator is mounted on a  $\frac{3}{4}$ " brass pipe flange by means of four bolts run through the end bell. A tiller made from steel bar stock with a wooden handle is attached by two screws.

The clamp that fits the boat transom consists of two pieces cut from  $\frac{3}{32}$ " cold-rolled steel plate, bent as shown and connected by two steel spacers at the top and



a strap yoke at the bottom. The spacers are tapped 5/16"-18 at each end to receive machine bolts. One spacer is also tapped for the transom clamp screw. This may be fitted with a crosspin as in the drawings, or with a pinned wing nut as in the photos.

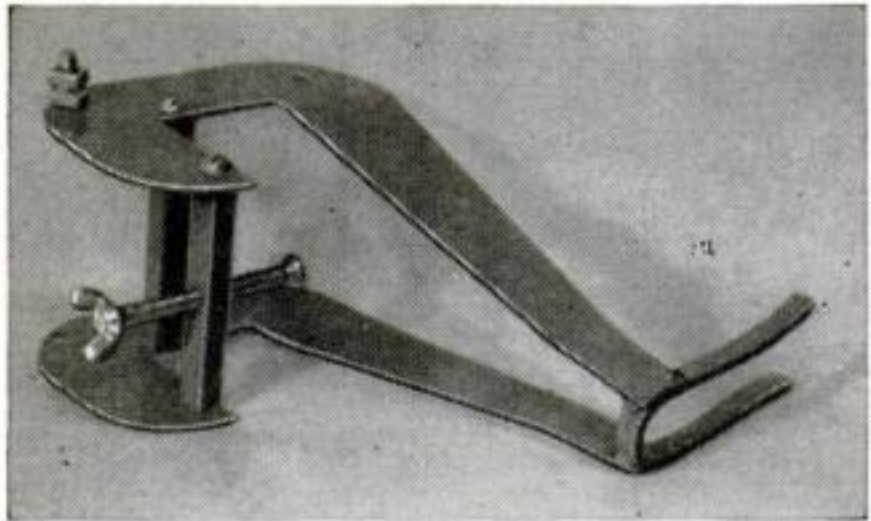
For the gearbox housing, procure a 3/8" length of 2 1/2" O.D. brass tubing with a 1/4" wall, or turn a piece to these dimensions from round brass. Care should be taken to drill the two 3/8" holes for the propeller shaft perfectly in line, preferably by drilling undersize and running a 3/8" reamer through.

A 3/4" brass pipe cap is drilled through to receive the lower bearing of the vertical shaft, and the two pieces are silver-soldered to the gearbox. The propeller bearing, turned and threaded as shown, is also silver-

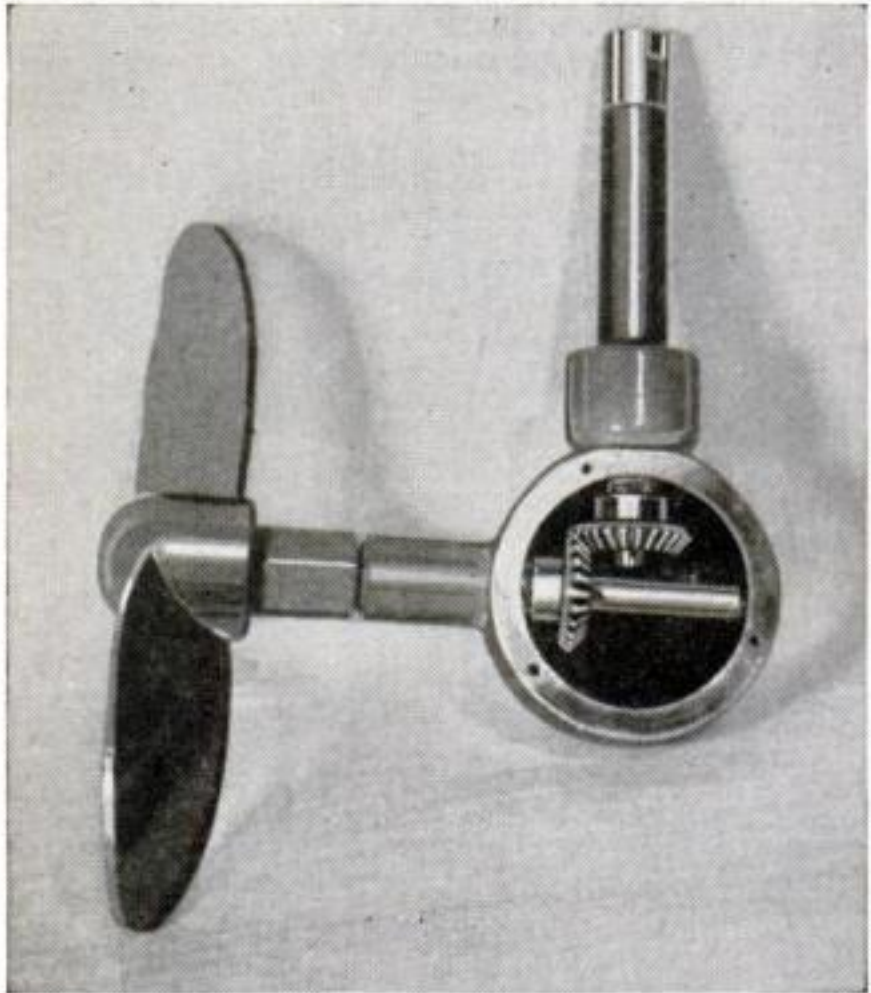
soldered in place. Take pains to get accurate alignment with the opposite hole. The threaded end of the bearing is counter-bored 7/16" to provide space for graphite cord packing around the shaft, which is held by the gland nut.

The ball bearing should be one designed for thrust as well as radial load, and a light press fit in the 3/8" hole. It is retained by a recessed brass disk, silver-soldered in.

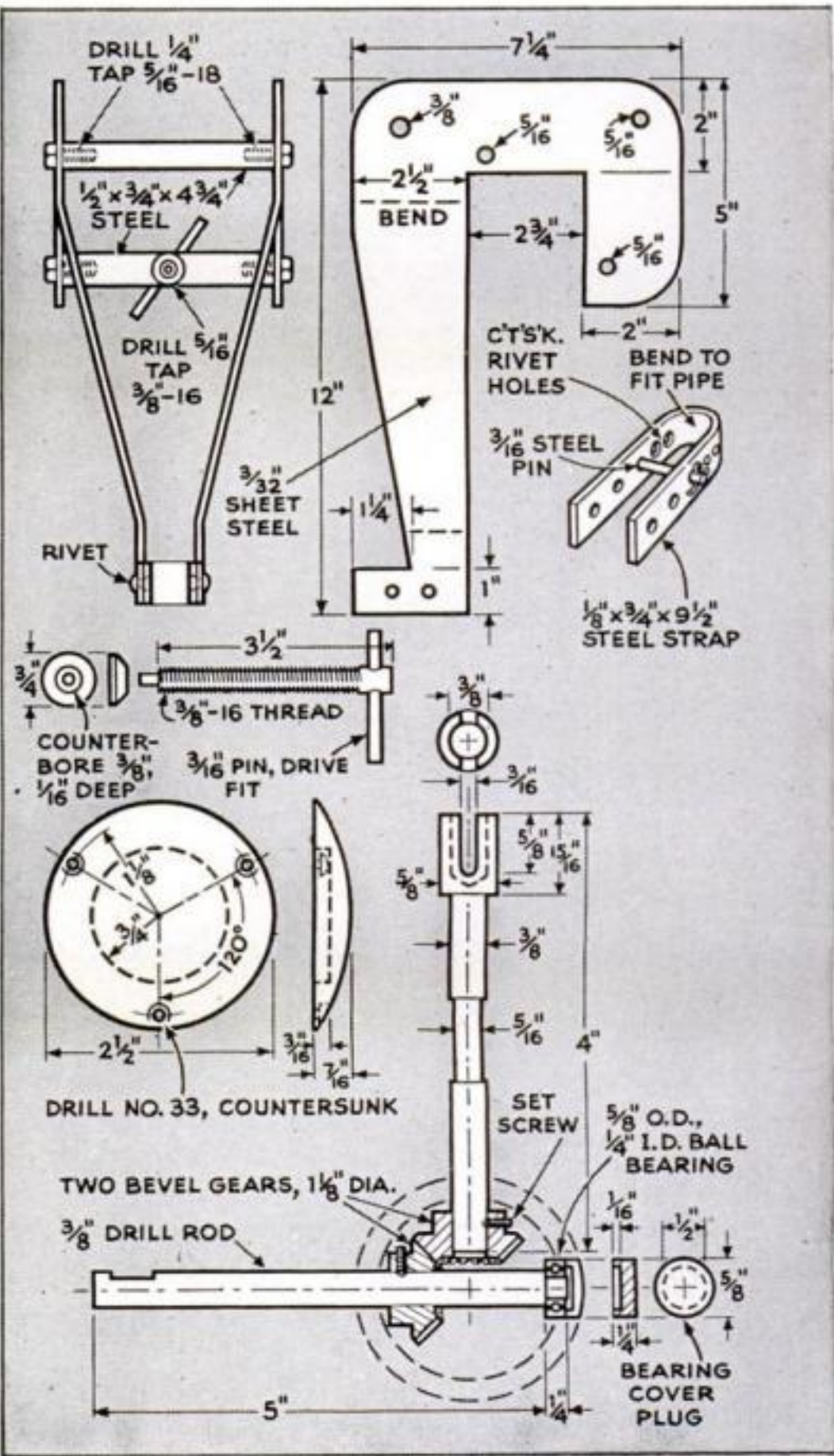
The propeller shaft is provided with a flat for the propeller setscrew and is shouldered to a tight fit in the inner ball-bearing race. The short vertical shaft, turned from 3/8" stock, is slotted at the upper end like the generator shaft. Two gear covers are turned from 7/16" brass, drilled for three screws, and used to spot tapped holes in



To adjust the shaft angle for horizontal propeller thrust on a slanting transom, a pin or bolt is put through the right holes in the U-shaped yoke.



Brass or bronze, easily machined and silver-soldered, should be used for all underwater parts but the shafts, which ideally might be stainless steel.





the housing. Cut paper gaskets to fit them.

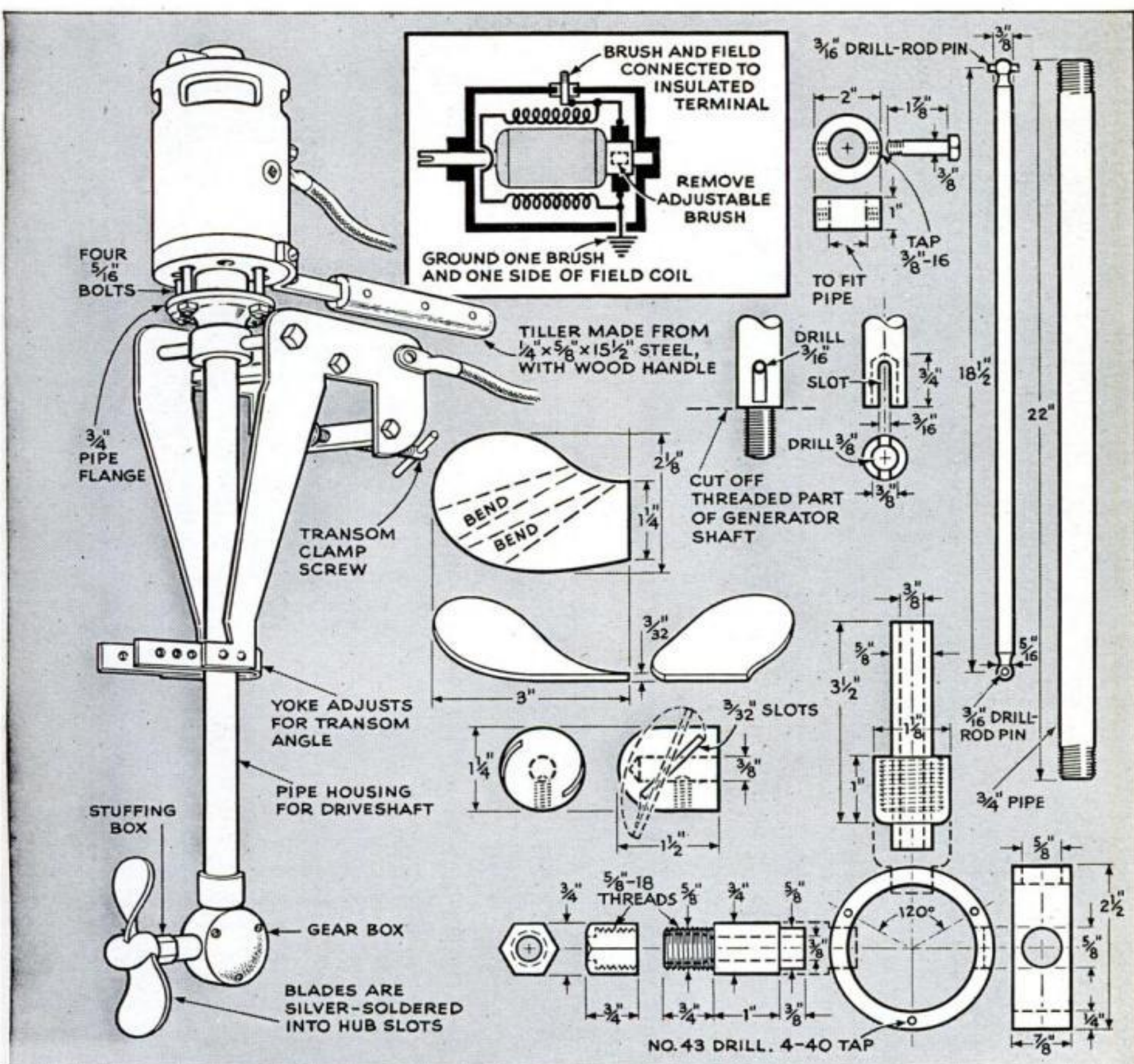
The  $\frac{3}{4}$ " floor flange to which the motor is bolted rests on a collar provided with two transverse  $\frac{3}{8}$ "-16 holes to receive the pivot bolts. The long vertical shaft, a piece of  $\frac{3}{8}$ " drill rod turned to a ball at each end and fitted with two crosspins at right angles to each other, and a 22" length of  $\frac{3}{8}$ " brass pipe complete the drive assembly.

Insert the propeller shaft in the gearbox, sliding it through the gear and into the ball bearing. Holding the second bevel gear in place, slide in the short vertical shaft and tighten the gear on it. Use thin brass or bronze washers between the lower gear and the sleeve bearing, and under the  $\frac{3}{8}$ " shoulder of the vertical shaft, to adjust gear mesh; they should have just sufficient

backlash to indicate that they are meshing freely. Pack the case with gear grease and fasten the covers in place. Also pack the  $\frac{3}{4}$ " pipe with grease and thread it into the lower socket, slip it through the pivot collar, and screw it into the motor flange. Then screw the pivot bolts in place.

A propeller is made by turning a  $1\frac{1}{4}$ " hub, sawing two slots at 45 deg., and silver-soldering in two blades cut from  $\frac{3}{32}$ " sheet brass. If you prefer, buy a ready-made one designed for use on very small gasoline outboards.

Fairly heavy cables, say No. 12, should be used from the battery, and if a switch is used, it should be a heavy-duty type. Should the motor run the wrong way, reverse by transposing the field leads. END

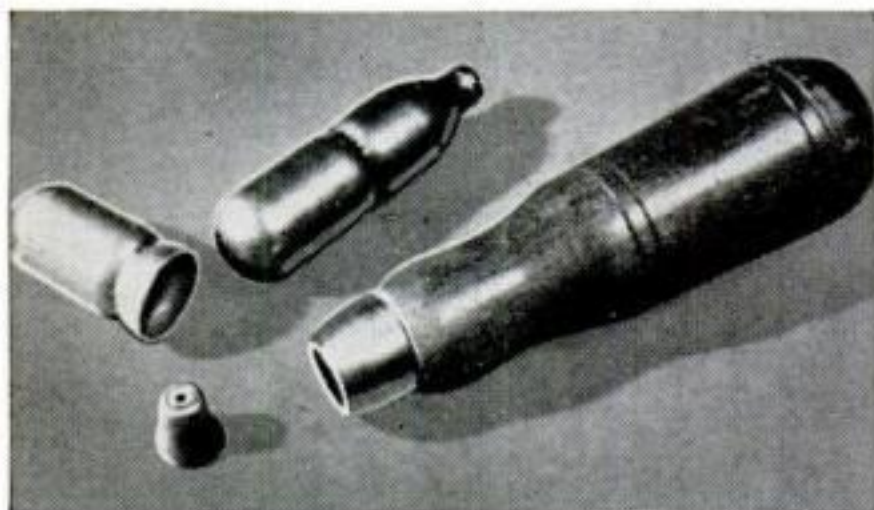
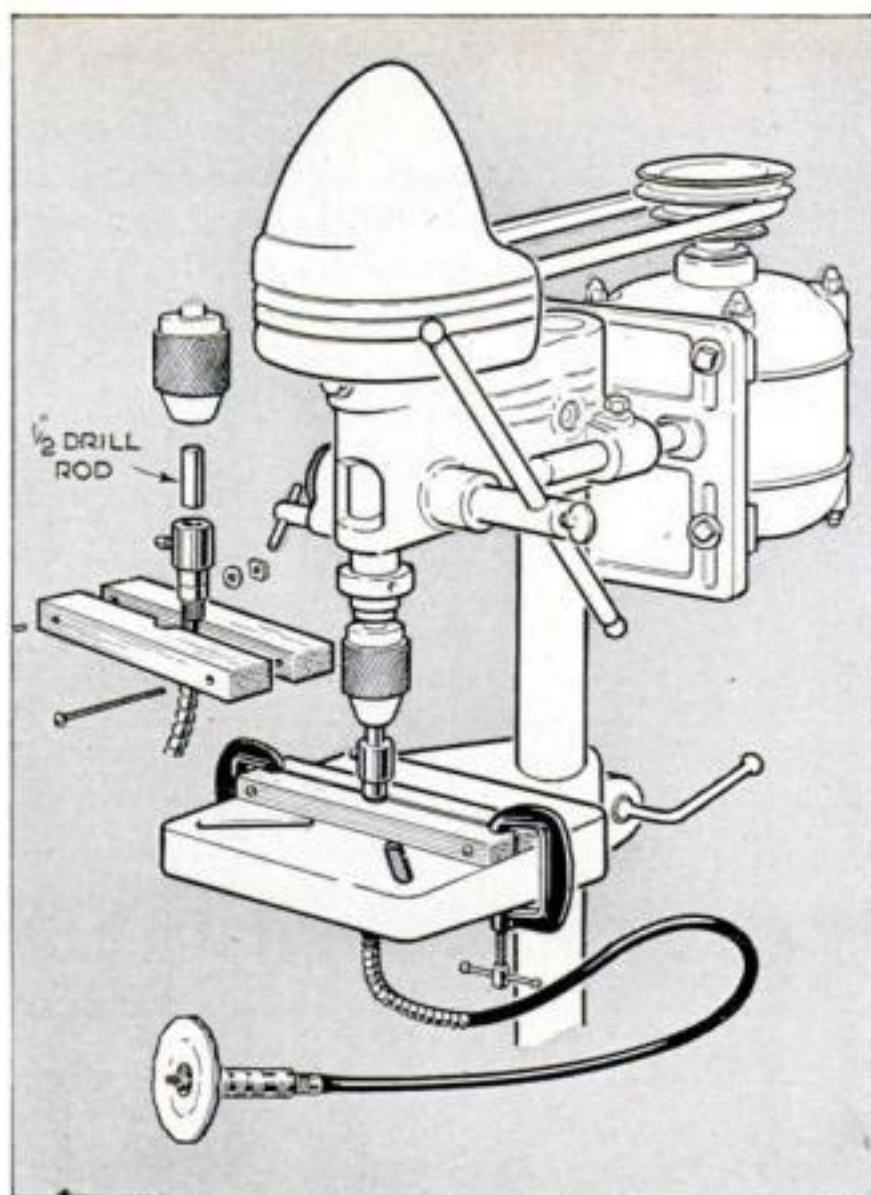




## NEW SHOP IDEAS

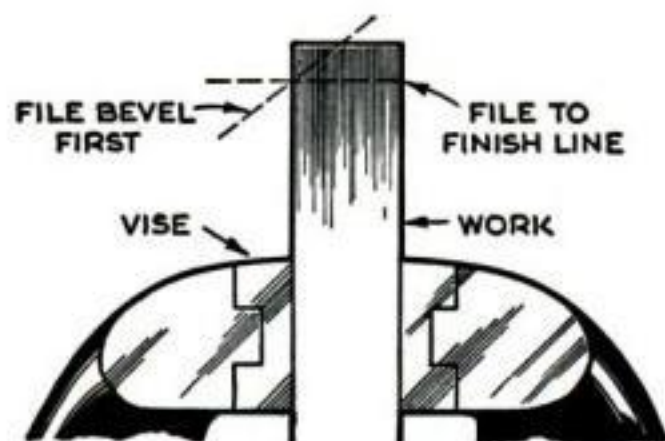
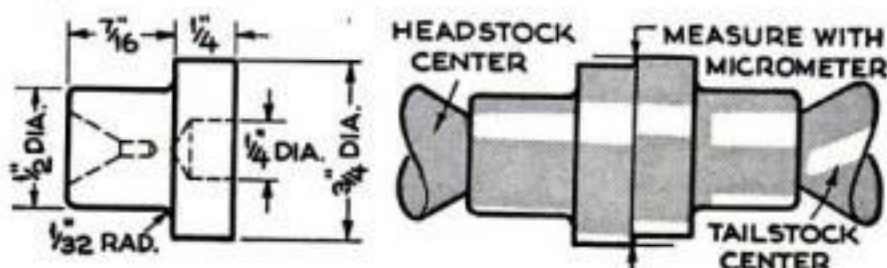


**DRILL RUNS FLEXIBLE SHAFT.** Two wooden clamp blocks convert a drill press into a multispeed power source for a flexible-shaft tool. A stub of  $\frac{1}{2}$ " drill rod or shafting acts as a coupling between the chuck and the driving end of the flexible shaft. To make the clamp blocks, take a piece of hardwood as long as the drill-press table is wide, drill two holes through at 90 deg. to the face for the clamping bolts, and bore a hole through the face for the flexible-shaft collar. Then cut the piece in half and assemble around the shaft. For minimum whip and vibration, line up the blocks carefully before clamping them to the table. The drill-press quill is, of course, locked in a low position during operation.—RALPH S. WILKES.



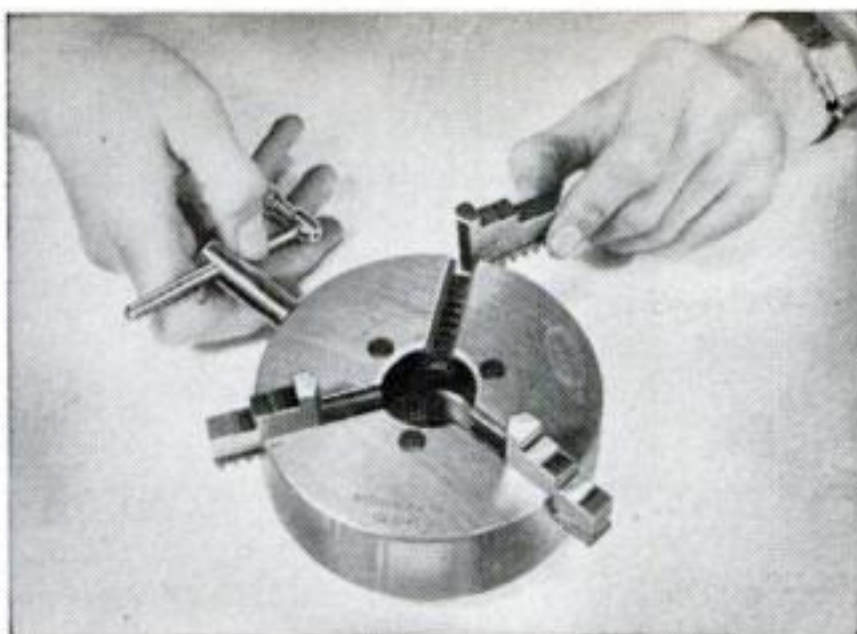
**FERRULE CUT FROM SODA BULB.** Hack-sawed into appropriate lengths, an empty carbon dioxide cartridge of the kind used with home soda-water bottles will give you two to three ferrules for homemade tool handles. Shape and smooth the ends with a file, and polish with fine emery cloth. Be sure the gas has been discharged before attempting to saw.—WILL THOMAS.

**TAILSTOCK REALIGNER.** Quick, accurate realignment of a tailstock after taper turning is easy with this device, which consists of two identical parts turned from cold-rolled steel. The two pieces are made as one, with the center section turned to a definite dimension, say .750". After parting, each piece is chucked, indicated, drilled to relieve the centers, and faced. The face of each part must be square with its axis. In use, the parts are inserted firmly between centers and "miked" as shown. Any misalignment of the tailstock is revealed as a reading higher than .750".—G. TAYLOR.

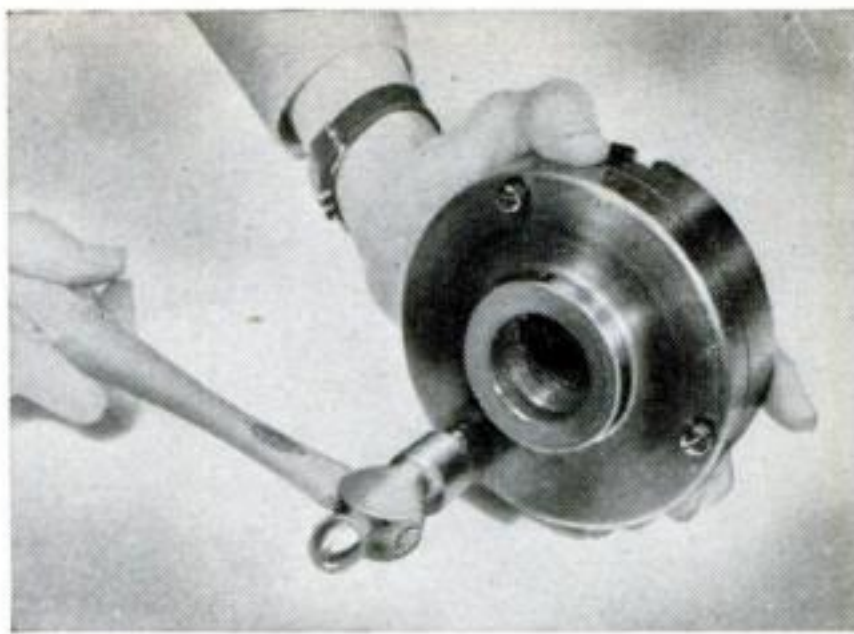


**FILING TO A LINE.** When you have to shorten a piece to a scribed finish line, first file a bevel on the marked side to the finish line, and then file down squarely to the base of the bevel. In this way the amount of material to be removed can be accurately controlled, and there will be less danger of taking off too much stock. On fairly thick pieces, it may be advantageous to file bevels on both sides before starting to file through the middle.—H. FOSTER GRISWOLD.

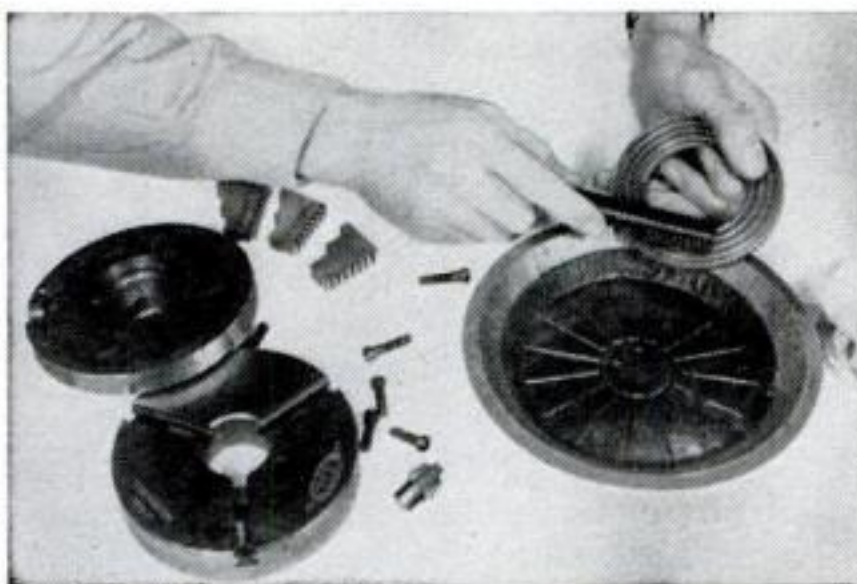




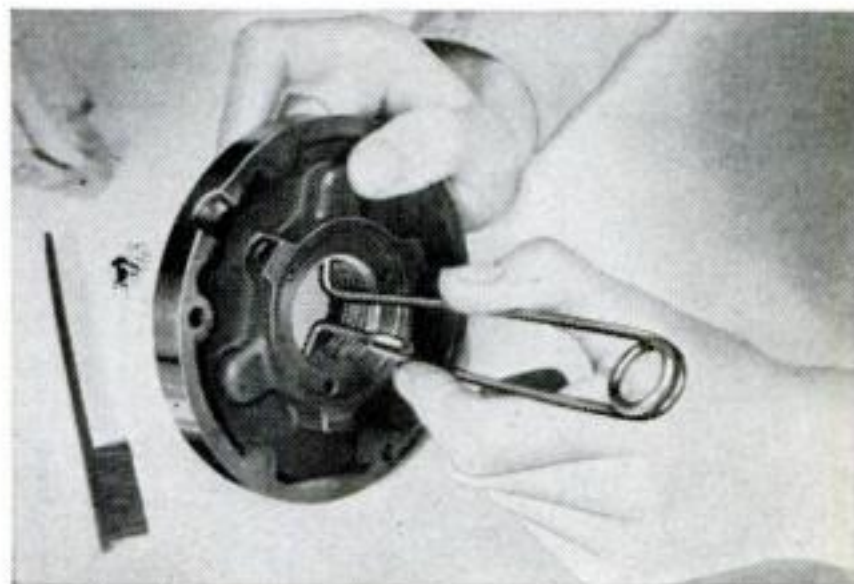
**1** To dismantle a lathe chuck for cleaning, take out the jaws first and then the body screws.



**2** Replace the screws on one side with slightly longer bolts. Tap them to release the parts.



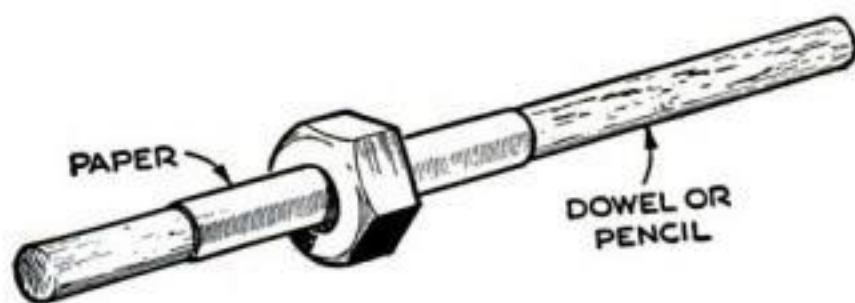
**3** Clean in kerosene to remove old oil and chips, and use a wire brush to get out gummy deposit.



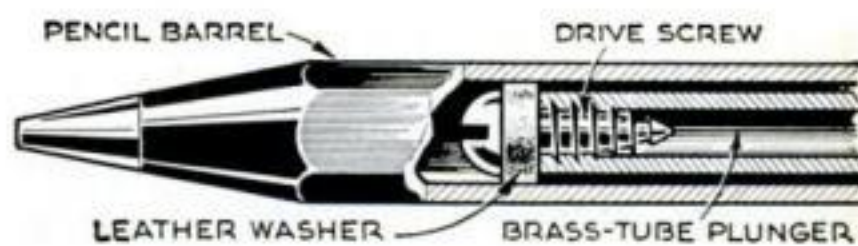
**4** To assure accurate alignment when the chuck is on the spindle, threads must be free of chips.

**HOW TO CLEAN A SCROLL CHUCK.** Besides getting a periodic oiling, a universal chuck must be kept clean to prevent undue wear and loss of accuracy. Some dirt and chips can be removed from the outside, but the chuck should be dismantled for a thorough job as soon as the jaws tend to bind or stick. Replace the body screws on one side

with bolts that will project  $\frac{1}{4}$ " when tightened, and hold the chuck in one hand when tapping these bolts to separate the other parts. After cleaning, sparingly oil the scroll bearings and other contact points with light motor oil. When reassembling, draw the body halves together by tightening the screws evenly.—RICHARD HANSCOM.



**COUNTING THREADS IN A NUT.** If you lack a thread gauge, an impression of the threads can be taken on a piece of paper inserted in a nut and twisted slightly with a finger, dowel, or pencil. A little oil rubbed on new threads will make the impression clearer. When the paper is taken out, the threads can be counted with the aid of a scale.—ROBERT FLYNN.



**PENCIL GREASES MODELS.** An old mechanical pencil with the inner parts removed can be made into a good grease gun for lubricating small machines and models. Make a plunger out of a brass tube with a leather washer screwed to the end. Fill the barrel with light grease or petroleum jelly, insert the plunger, and force grease out at the nozzle.—RALPH K. MENSING.



## Vertical Steam Engine with Reverse Gear PART THREE

# Making the

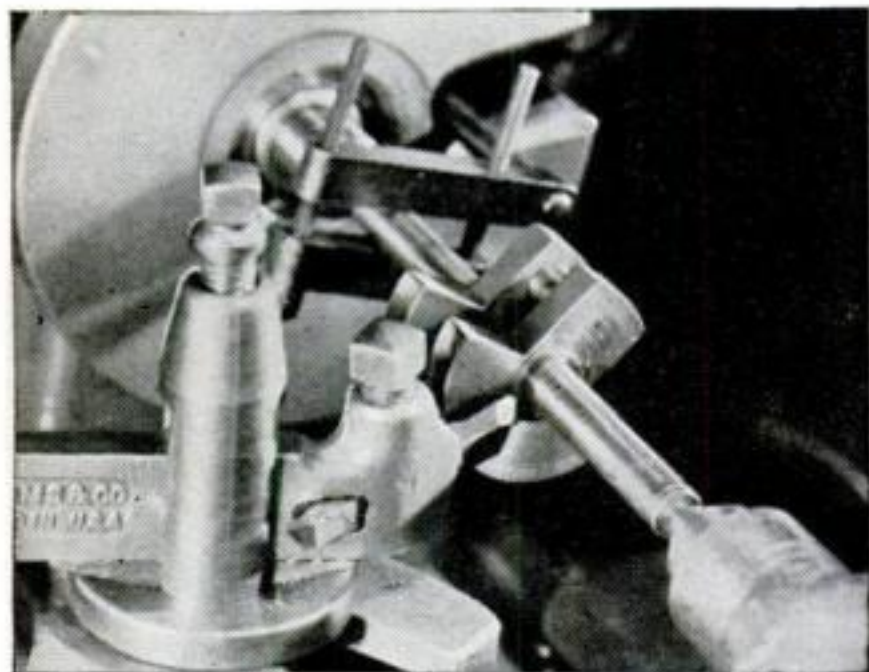
*By C. W. Woodson*

**A**N ACCURATE, true-running crankshaft is necessary if the model steam engine is to work freely and use steam with maximum efficiency. This part is assembled from a shaft, two webs, each with an integral counterbalance, and a crankpin. All are made up from solid steel stock, the webs cut with a hacksaw and filed to shape from two 5/16" disks and the shaft and pin cut from drill rod.

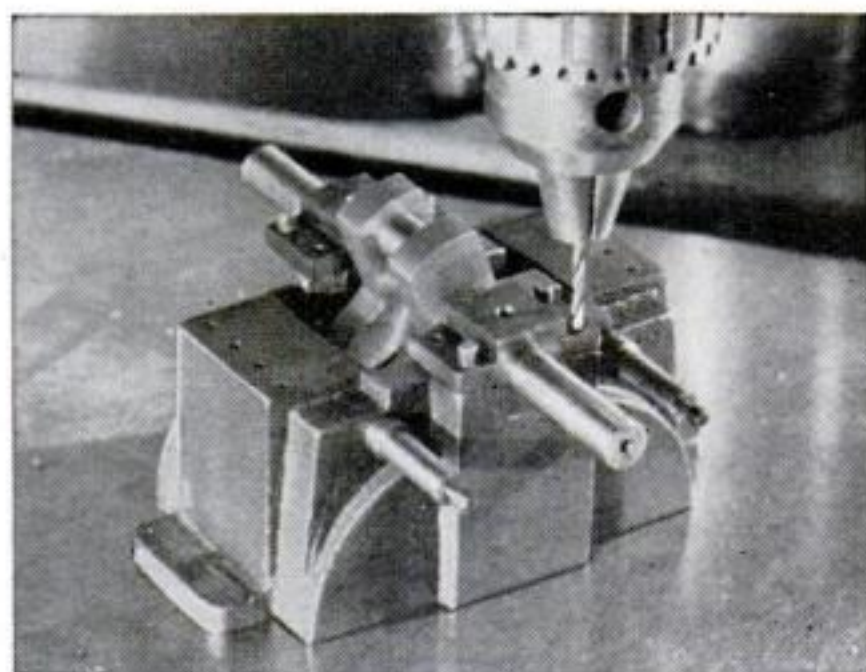
Clamp the webs together and drill them at the same time for a drive fit on the shaft and pin. Because the shaft is cut as one piece 4 7/8" long and must be driven a considerable distance, it may be necessary to ream the 3/8" holes for it slightly. Press both webs on the crankpin first. Next, with a block between the webs to prevent bending the pin, drive the crankshaft through. Then drill and pin all parts. Pieces of bicycle spoke make good pins.

The assembled crankshaft is next mounted between centers in the lathe and with the block still between the webs. Face the outer web sides smooth, form the 1/32" collars, and turn the outer rim of the balance weights and the ends of the webs smooth and to exact diameter. Finally cut out the part of the crankshaft between the webs and file the inner faces smooth. Key-

Alignment of the two ends of the shaft is assured if it is made as one piece and cut when pinned in place. The flywheel is turned from a casting.



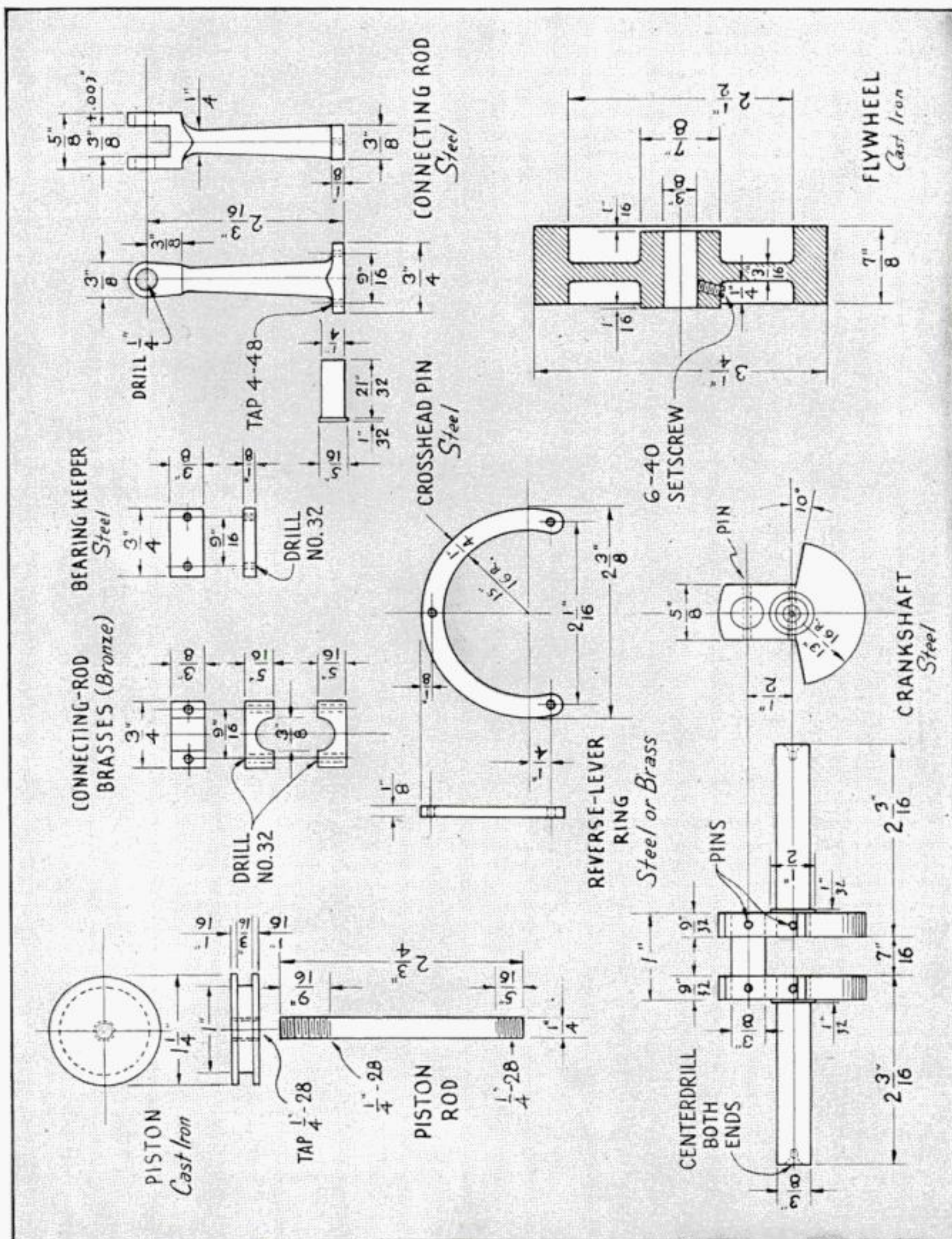
Mounted between centers, the crankshaft is faced smooth on the webs and the collar turned. A block between the webs prevents distortion.



Holes for the bearing bolts are drilled through the bearing caps while the crankshaft is in place to assure alignment of the bearing halves.



# Crankshaft and Running Gear



All dimensions for the crankshaft, flywheel, connecting rod, piston, and piston rod are shown in the drawing. The reverse-lever ring is also shown and may well be made at this time.



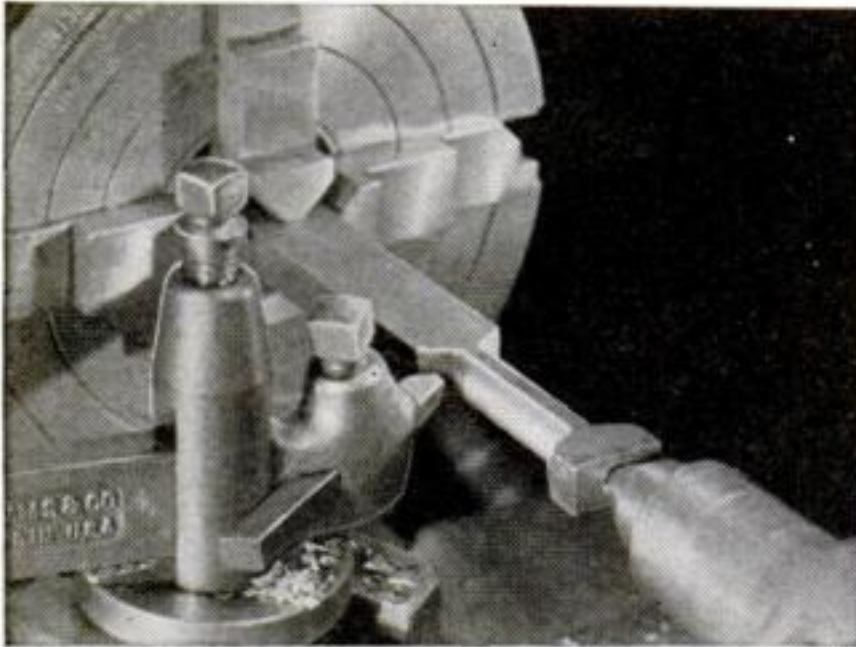
ways or setscrew flats are optional, depending on the use the engine is meant for.

Fit the finished crankshaft into the bearings next, clamp on the bearing caps, and rotate the shaft to make sure it turns freely. There should be no binding, since shaft alignment is insured when the webs are pinned before cutting out the center portion. With the shaft in place, drill and tap the bearing holes and bolt both caps down.

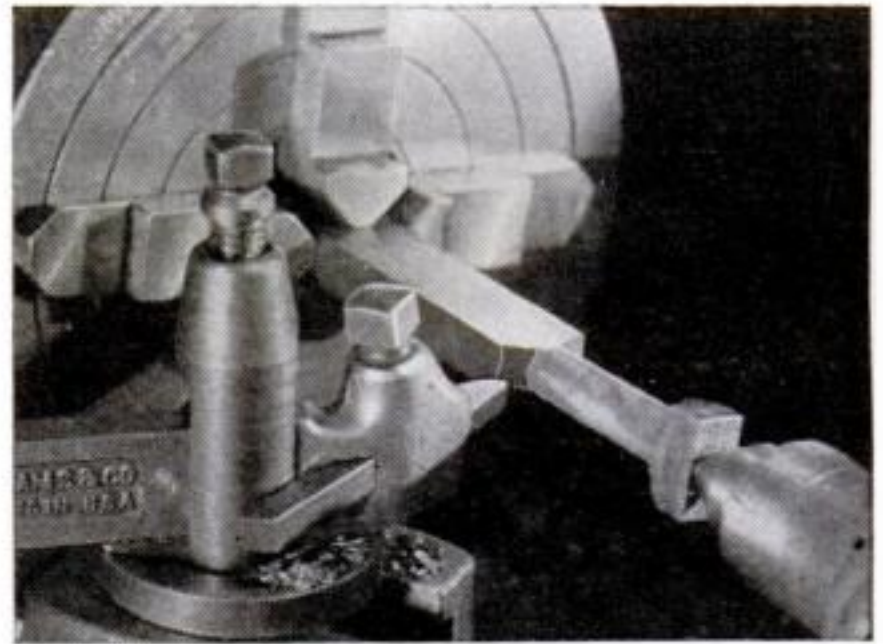
The connecting rod is rough-turned to shape from  $\frac{3}{8}$ " by  $\frac{1}{4}$ " steel bar in the four-jaw chuck. It is removed and heated to a bright red, and the small end is twisted 90 deg. This can be done with a heavy wrench while the work is held in the vise. Then the piece is rechucked, its tapered section turned to shape and polished bright, and the work cut off. Drill, saw, and file the forked end to shape, and drill for the connecting-rod pin. Turn the pin to a force fit in the fork or thread it for a retaining nut.

Make up the connecting-rod brasses from flat bar bronze stock and the connecting-rod keeper from steel. Cut to length and drill for the screws that hold them to the connecting rod. Drill and tap the end of the rod and with two 4-48 steel screws assemble brasses and keeper on the rod. The crankpin hole is then drilled and reamed through the bearing brasses, and the end assembly is filed accurately to size.

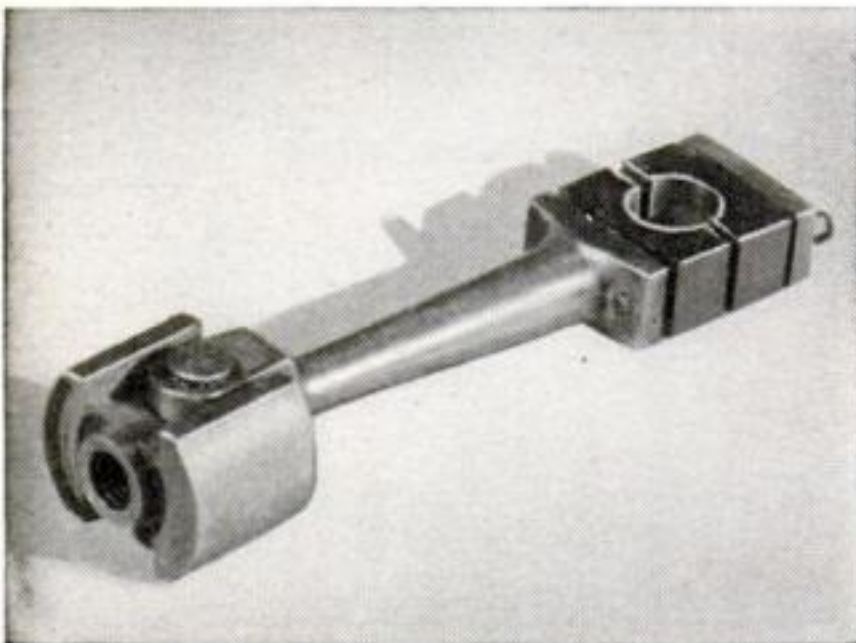
Centerdrill a  $2\frac{1}{4}$ " length of drill rod for the piston rod, thread both ends, and screw it into a hole drilled and tapped in a rough piston blank made from a  $\frac{3}{8}$ " steel disk. Mount the work between centers and face both sides of the piston so it will run dead true. Then turn it to a nice sliding fit in the cylinder bore and cut the groove to width and depth for the piston ring. This ring, being a standard size, can be purchased, though one can be made up in the lathe from a short bar of cast iron if the



Steel bar stock is rough-turned to shape for the connecting rod, removed from the lathe, heated a bright red, and the small end twisted 90 deg.



Back in the four-jaw chuck, the connecting rod is turned for the taper, which is polished bright, and the piece is then cut off to length.



This is the connecting-rod assembly. The brasses are drilled and reamed while screwed together to give a nice running fit on the  $\frac{3}{8}$ " crankpin.



The piston is turned from a blank that has been drilled, tapped, and screwed to the piston rod. It is faced true, turned to size, and grooved.



modelmaker is experienced in ring turning.

Enough of the parts will now have been completed so that you can make a trial assembly and test the piston travel. Assemble the base, the column or standard, the bottom cylinder cover, the cylinder itself, the piston and piston rod, and the connecting rod. Leave off the top cylinder cover so the movement of the piston can be checked. Likewise it will be unnecessary to put in the glands for the test.

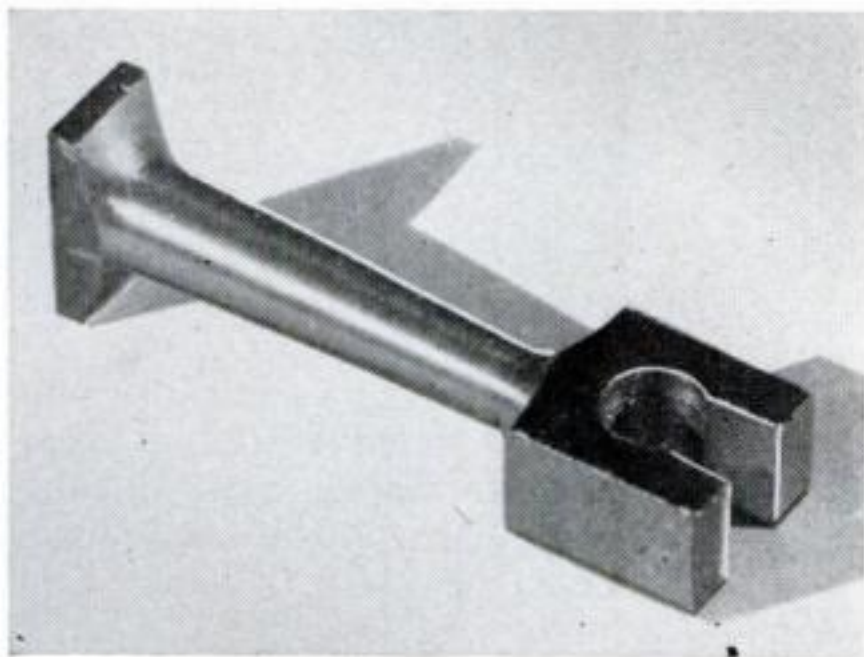
If the machining has been accurately done, the assembled engine should work freely when the crankshaft is turned. Note carefully the travel of the piston, which should be the same distance from the top and bottom of the cylinder, clearing at both points by  $1/32''$ . If it should hit at the bottom, the piston rod can be turned a little further out of the crosshead. Place the top cover on the cylinder and again move the piston through its travel. Any binding at

the top will indicate that the piston is striking there, and a shortening of the piston rod will be necessary.

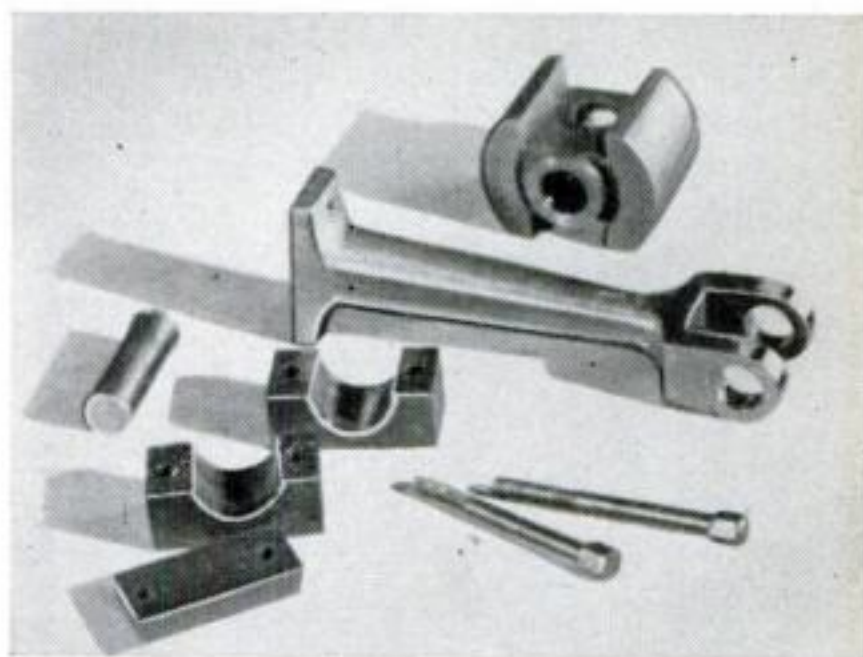
The reverse-lever ring is a section of a circle turned from a square piece of  $\frac{1}{8}''$  steel plate. It is first chucked in the four-jaw chuck, where the center is bored to size. Rechucked in the three-jaw with the expanding jaws gripping inside the hole, it is brought to proper outside diameter. A section of the ring is next cut out, and the holes are drilled for mounting the part on the engine base.

After so much work on bar stock, machining the flywheel will be a pleasant relief. This is made from a fine gray-iron casting. It is rough-turned to size in the three-jaw chuck, and the shaft hole is then drilled and reamed. The work is next mounted on a mandrel held between centers, and the hub, edges, and inside of the rim are faced to run dead true.

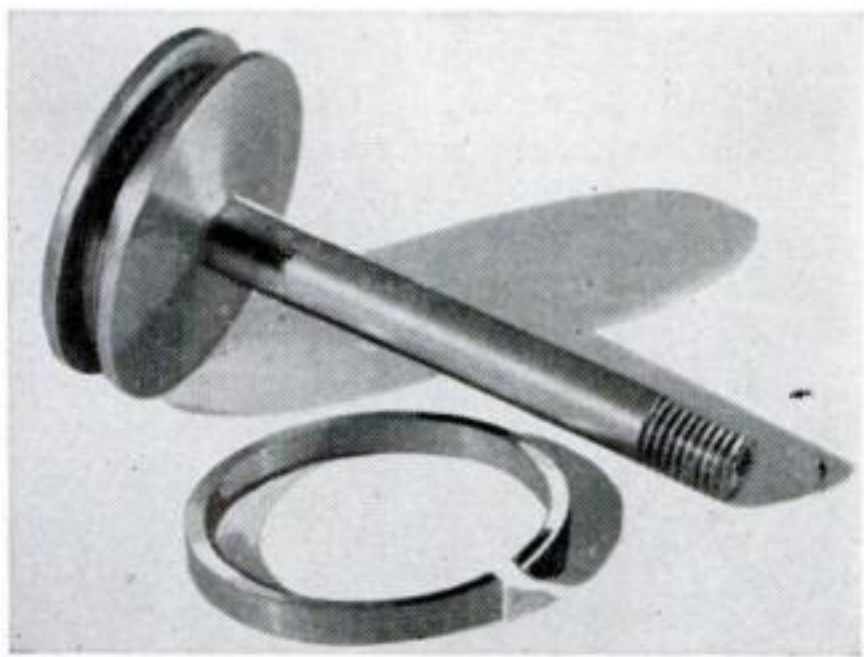
TO BE CONTINUED



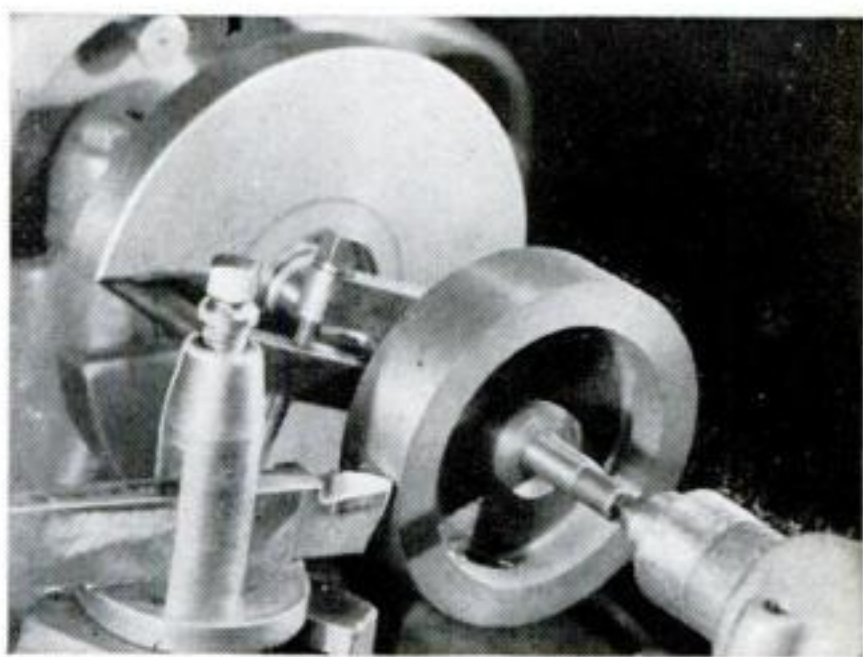
Shaping of the forked end is begun with a drilled hole and rough sawing, and the fork is brought to final dimensions by hand filing or milling.



Here the connecting rod is shown with its keeper, brasses, pin, and screws, together with the crosshead, which was described in Part I.



It will hardly pay to make your own piston ring, which is a standard size readily available. It is shown here with the completed piston and rod.



Rough-turned to size from a casting, drilled, and reamed, the flywheel is next mounted on a mandrel and its rim and hub are faced to run dead true.





Artistic photographic prints on plates decorate them interestingly for display on a wall. Still another use of the process (center) is on drinking glasses. At right, a photo turns a candy box into a jewel box.

# Print Your Photos Anywhere

**By Louis Hochman**

**W**OULD you like to print your own favorite photographs on china, glass, plastic, and other surfaces? A prepared emulsion, easily applied to any surface, will permit you to add that personal photographic touch to dishes, glassware, costume jewelry, wooden and metal boxes, clothing accessories, and a score of other materials. Whereas previous methods yielded prints of poor tonal quality, this one produces results comparable to a well-exposed print on good enlarging paper.

The emulsion, originated by the Glenn L. Martin aircraft company for printing patterns on sheet metal, is available in small quantities for home use. Though glutinous as it is taken from the bottle, it is heated to a free-flowing liquid to be made ready for use. In that form it is sprayed or brushed on the object selected to take the print, converting it into a photographically sensitized surface. Then the print is made from the chosen negative by contact or projection and developed almost exactly as on paper.

That's all there is to it—hardly more trouble than conventional printing—and yet the possibilities remain virtually unlimited. Favorite negatives can be printed on book covers, beverage sets, dinner and decorative plates, scarves, pillowcases, stationery, furniture, luggage, jewelry cases, and candy boxes. Interesting textured results are possible with a variety of fabrics, metals, plastics, woods, leathers, and artist's boards.

Smooth and closely woven materials naturally will take a better print than coarse or open surfaces, but the limitations are relatively few.

With a little extra imagination exercised in the choice of subject matter, picture stories can be told on the decorated surfaces. Highly acceptable personalized gifts can be contrived with miniature portraits of friends printed on cigarette cases, vanity sets, plastic or enameled brooches, unengraved signet rings, and the like. A baby, snapped at mealtime, could be reproduced on a set of feeding bottles. If you like the waggish or bizarre, a picture of yourself garbed as a beggar might adorn your wallet. Again, an animal, fish, or snake might decorate a decanter or beverage glasses.

As a novelty, you can print the photograph directly on plywood and then jigsaw the outline and mount the piece on a stand for a desk ornament. The effect is similar to that of regulation photographs mounted on board and similarly jigsawed, the photographic quality is equally as good, and there is absolutely no possibility that the photo will become detached.

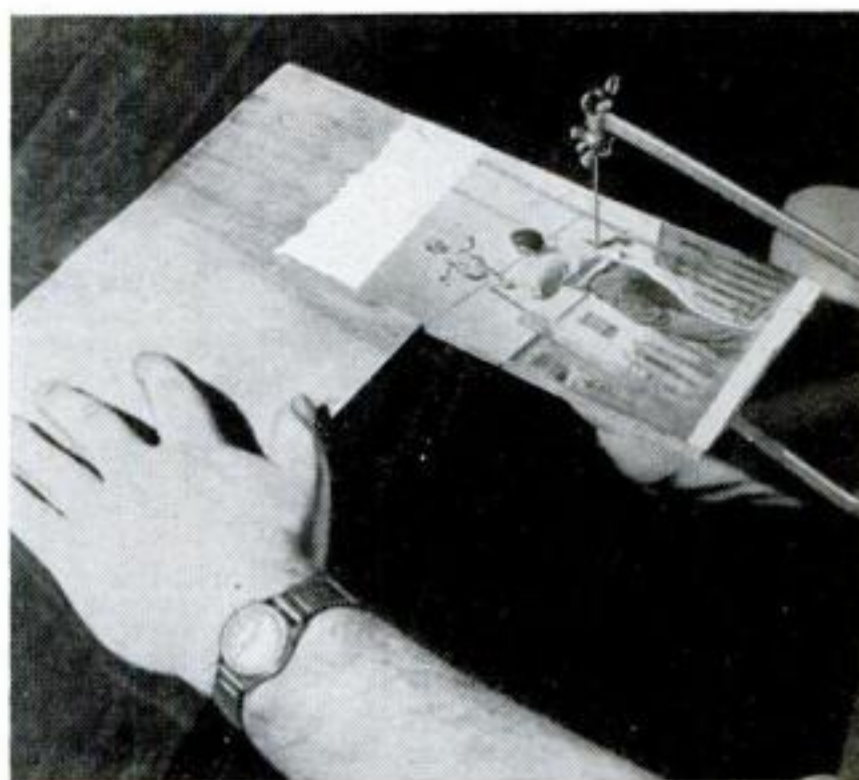
Equally effective are jigsaw puzzles made from your own negatives directly on the surface of the wood and protected with clear lacquer or varnish before the pieces are cut out. Puzzles thus made will stand years of use without peeling.

These are but a few suggestions to open up a wide new field for the amateur-photography enthusiast. With a little experience

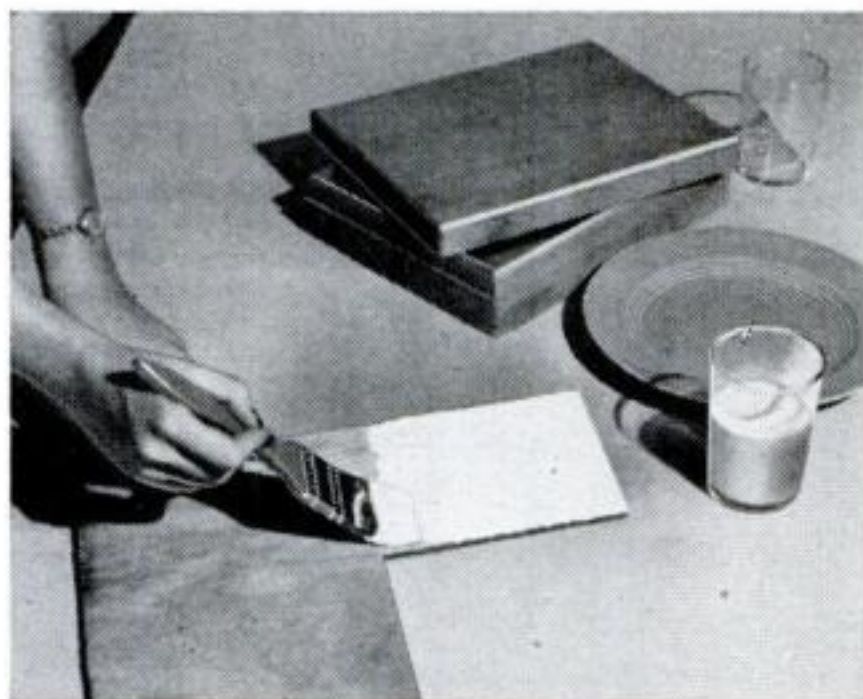




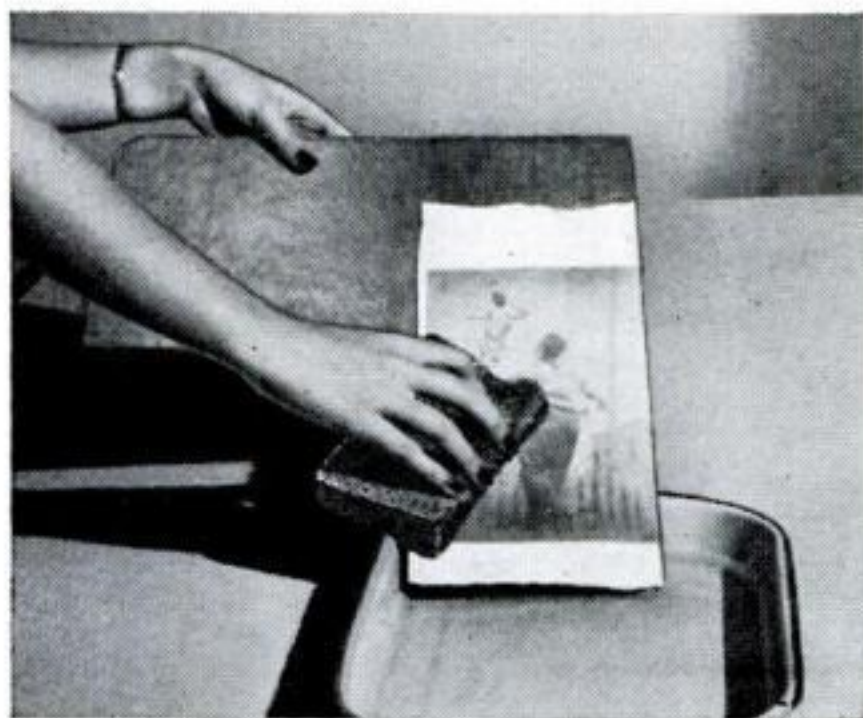
**1** Heating reduces the gelatinous emulsion to a liquid for applying readily with either a brush or spray gun. All work is done under a safelight.



**4** A photo novelty is created by sawing the figure outline. Prints are made similarly on an almost unlimited variety of materials.



**2** Plywood is sensitized with the substance in order to take the photographic print. White enamel as an undercoat keeps grain from showing.



**3** After exposure under the enlarger in the conventional manner, the print is processed by sponging with the developing solution and the ordinary baths and rinses that follow.



**5** Here is the completed job. The plywood photo mounted on a stand that supports it erect is suitable for desk display. Jigsaw puzzles can be made the same way from favorite negatives.





Negatives can be blocked out with negative opaque when only a portion is wanted for printing on the sensitized surface. That was the treatment given the cat print on the tumbler on page 194.



Highly personal writing paper is made by putting a portrait of the writer in the corner. Usually the developer, short stop, and hypo won't do any harm to material water alone will not damage.

and a fertile imagination, you will be able to discover many more exciting applications.

Absolute cleanliness should be the rule in using the emulsion, just as it is in other photographic development, and the substance should be handled, of course, only in a darkroom under a safelight. Melt it down in a beaker or tumbler set in a pan of water previously heated to about 115 deg. F. Take care to keep the temperature below 125 deg., for at that heat the emulsion fogs. When you become proficient, you may find it convenient to heat the substance over the fire in the top of a double boiler.

Arrange the object on a table covered with clean wrapping paper and place the surface to be coated level. Pour a little of the emulsion in the center and spread it quickly and evenly with a swab or soft-bristled brush. After the first coat has dried, apply a second in the same way. If preferred, the two coats can be sprayed on.

Thoroughly clean the surface to be coated and rinse with distilled water to remove all traces of foreign matter before attempting to apply the emulsion. Metals such as aluminum, brass, copper, and galvanized iron should be degreased and given a foundation coating of collodion. Plastic and glass surfaces should be washed with soap and water and rinsed in distilled water, and the emulsion used on them requires mixing with a minute quantity of a wetting agent.

The emulsion is transparent after process-

ing, and therefore it is important to know what effect you want before applying it. Patterns and grain textures in wood and other materials will show through the finished print, and the result may not always be desirable. To avoid this, the surface may first be given a coat of white enamel, or tinted prints can be obtained by using colored enamel for the undercoating. The prints have the qualities of transparencies on clear glass and should be viewed by transmitted light for best results.

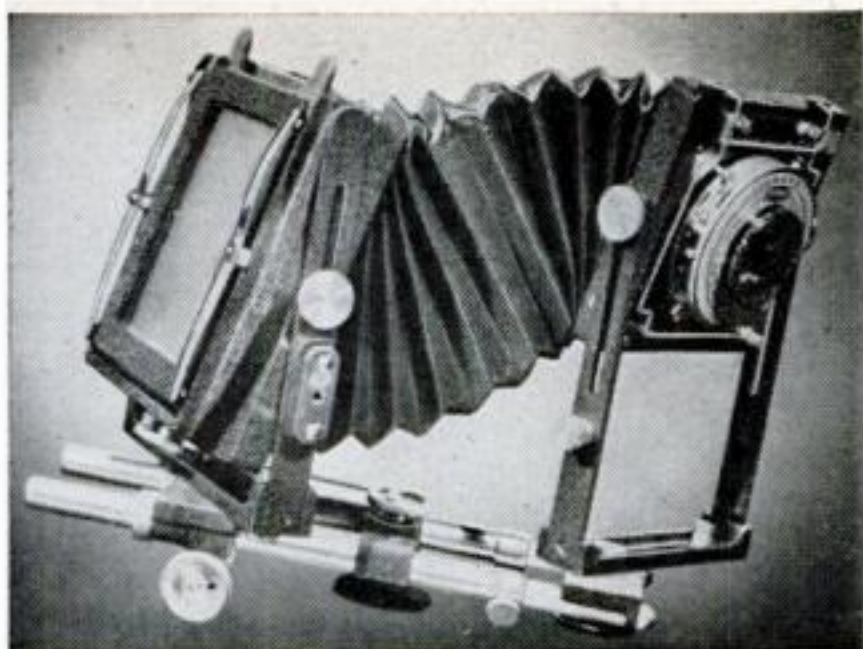
Cloth should be stretched and tacked or held in an embroidery frame before receiving the emulsion. Masking-tape borders will help to localize the areas being sensitized and serve as guides during exposure.

The exposure is made like that for other bromide emulsions. This coating, however, is almost twice as fast as, for instance, Defender Velour Black, and test strips should be made before attempting a final print. A good developer is D-72 used one-to-one. Follow with the usual short stop and hypo, and wash the print in running water for an hour before allowing it to dry.

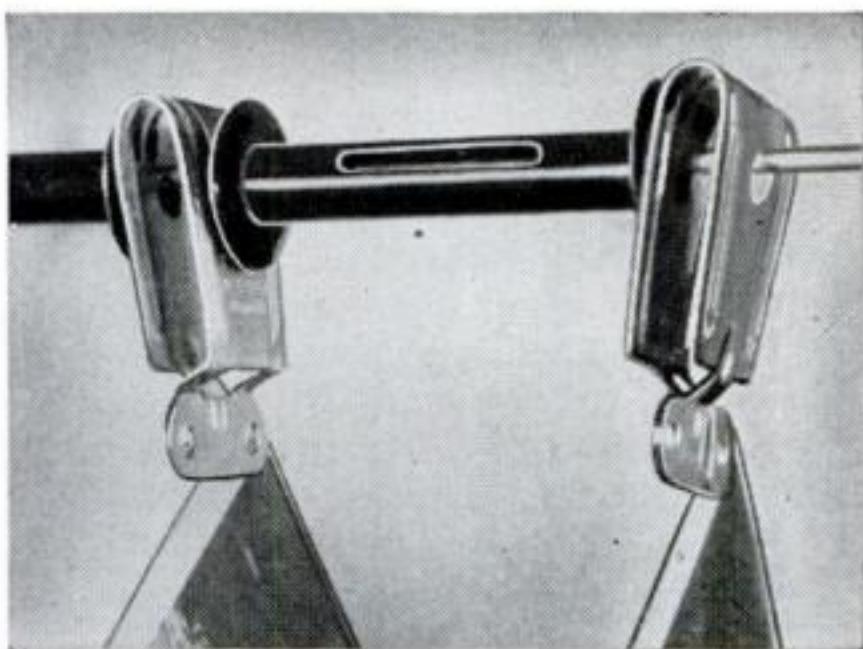
Many of the commercial toners are effective for toning images on the emulsion to various colors, but it is a good idea to try a test strip in the toner first to check its reaction. Oil and water colors can also be used to give the print natural colors. Finally, the image should be protected with a coating of clear lacquer.

END





**COMBINED PRESS-VIEW CAMERA.** Fast-action adjustments on this universal 4" by 5" camera make it suitable for news photographers. Front and rear focusing, unusual flexibility of tilt and swings, a reversible bed, rotary back, and a 17" bellows render it a view camera as well. Either film or plates may be used. It is made by the Brand Camera Co., of Los Angeles.



**FILM SPACER.** Spools strung out on a tight wire line prevent negatives from touching each other while drying. The spools are placed between clips as shown in the photo above.—TERRELL NICHOLS.

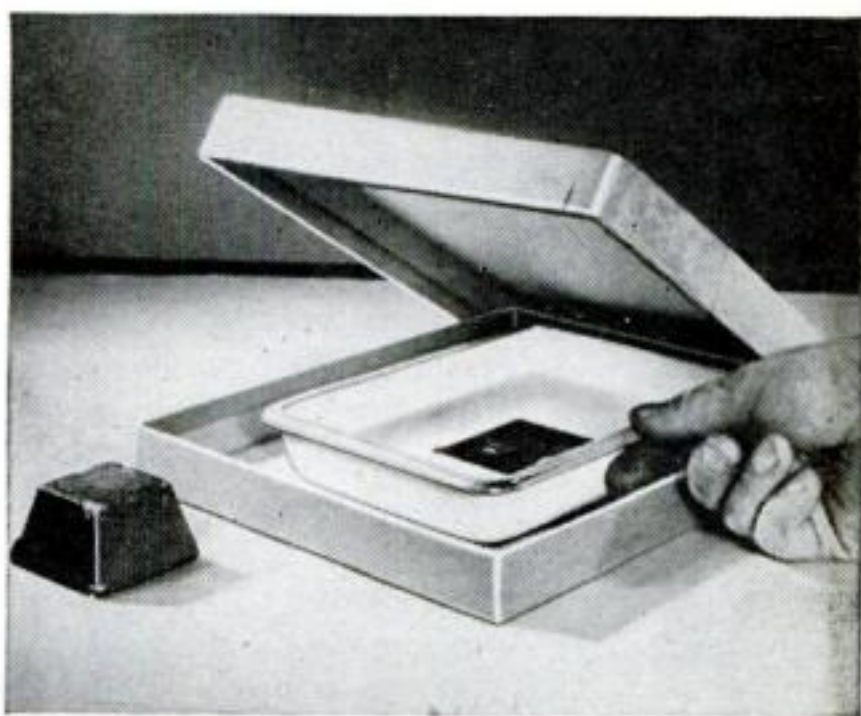


**TELEPHOTO LENS.** A new telephoto lens, the Magni-Far, is designed especially for Argus series C cameras, and utilizes the camera's built-in lens as part of the optical system. The Morton Company, of Minneapolis, intends to produce other range-extending lenses, each one for a specific camera. About \$50.



## PHOTO IDEAS and EQUIPMENT

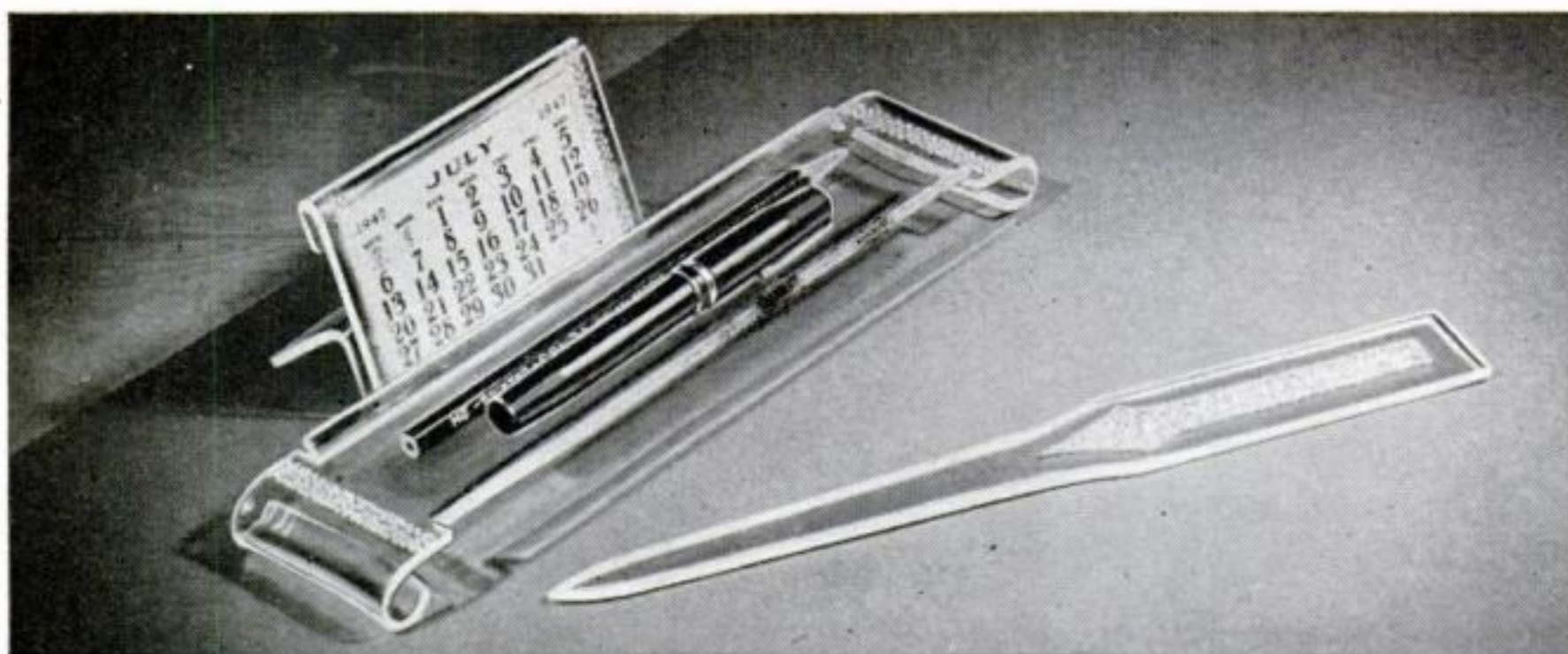
**DEVELOPING IN THE LIGHT.** You needn't rock a tray in the dark for 12 to 15 minutes during the first development of one or two color films or prints. After the film is immersed, place the tray inside a cardboard box with an overlapping, light-tight lid. The light can then be turned on while the tray is being rocked. It is necessary to turn off the light only when transferring the film or print to the short-stop bath.



**POLISHING FERROTYPE TINS.** Chemically treated cloths of the kind used for cleaning silverware are excellent for polishing ferrotype tins. Rubbing the cloth on a tin that has been moistened with a few drops of water quickly produces a clean, glossy surface to which your prints will not be able to stick.—WILL THOMAS.







## Chipping Gives Texture to Plastic

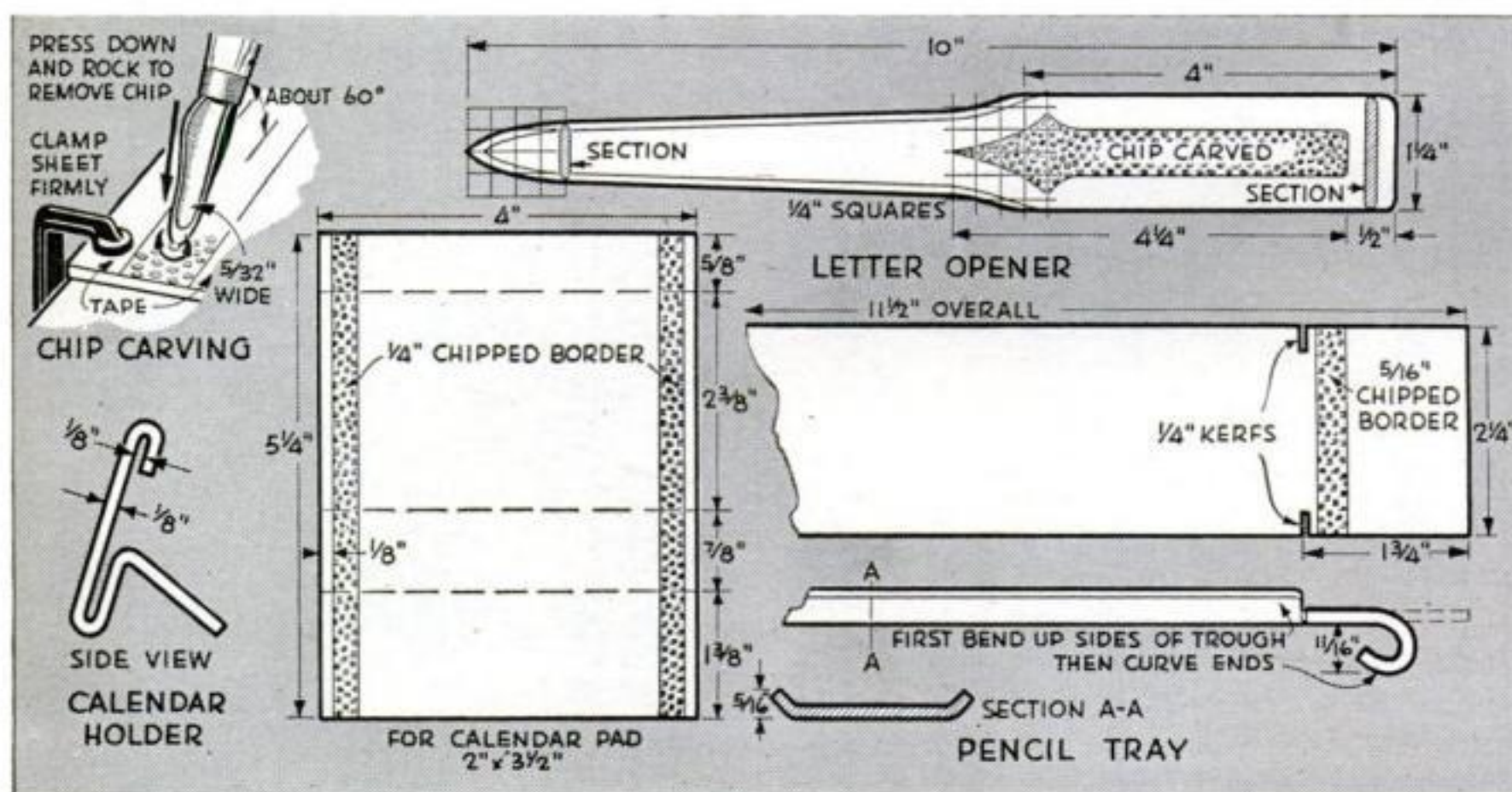
**T**HIS clear-plastic desk set is decorated by a new technique that gives texture to ordinarily glass-smooth lucite and plexiglas. The calendar holder, pencil tray, and letter opener are sawed from  $\frac{1}{8}$ " stock and then chip-carved with a  $\frac{5}{32}$ " linoleum-block gouge. Outline the area to be chipped with a china-marking pencil and clamp the work. Gouge out a chip by pressing down firmly and twisting the gouge slightly until the chip is worked out. Practice on scrap first.

File and sand the edges of all pieces

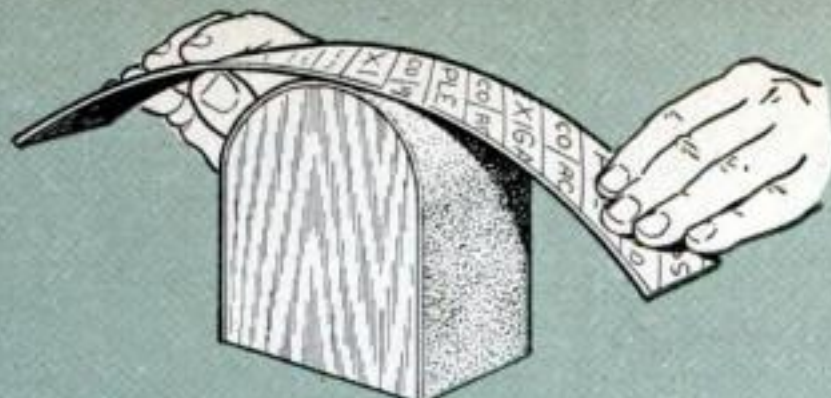
smooth after chip-carving has been completed. Bevel the letter-opener blade to sharpen both edges, but round the point a little to make it safe.

Heat the calendar-holder blank only where it is to be bent by shielding other areas with sheet metal and exposing it to a heat lamp 8" away. Then bend with gloved hands over a  $\frac{1}{8}$ " thick wood guide rounded at top and bottom and wide enough to provide space for the calendar pad to slip in. Bend the stand end simultaneously over another strip.

The pencil tray is best formed upside down. Lay the plastic on a  $2\frac{1}{2}$ " by 8" wood strip with beveled edges, heat, and when soft roll the ends over dowels. Fast work is required. Reheat if the first attempts are not successful. Those who like color may dye the textured portions.—FRANK SHORE.



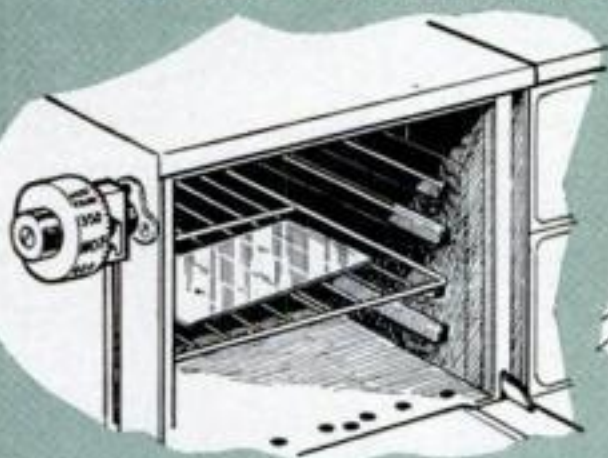




BENDING HEATED PLASTIC OVER A FORM



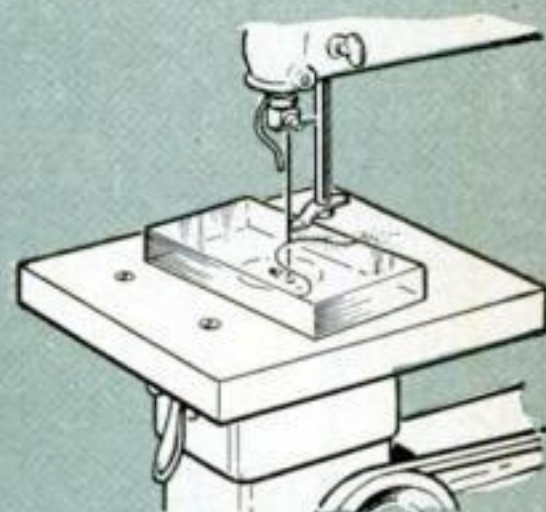
## WHAT'S WRONG



HEATING SHEET TO BE SHAPED



BREAKING  $\frac{1}{8}$ " SHEET ON SCRIBED LINE



JIGSAWING CURVE IN  $\frac{3}{8}$ " STOCK

CORRECT techniques for working clear acrylic plastics are part of the modern craftsman's lore. How many of these new skills have you made your own? Can you spot the errors in the operations shown above? There are two in Figs. 1, 2, and 4, but only one in Fig. 3.

4. Masking paper should be left on for sawing. Plastic  $\frac{1}{8}$ " thick will "burn," or soften from the friction of cutting and solidify again behind the blade, if the latter is as fine as that shown. A coarse-toothed blade is needed.

1. Masking paper must be removed before heating. If the hot sheet is to be hand held, gloves should be worn.

2. The oven regulator is set too high; excessive heat may blister the sheet (300 deg. F. is ample). The plastic should rest on smooth blocks, and not on the oven rack, from which the soft surface will take impressions.

3. Stock  $\frac{1}{8}$ " thick should be sawed. Breaking along a scribed line is practicable only with thin sheet up to about .080" ( $\frac{1}{12}$ " ) thick.

### ANSWERS

## CONCRETE PROPORTIONS

[HANDY MAN]

Specifications for concrete mixtures always give the proportions by volume, such as 1:2:4, which means 1 part cement, 2 parts sand, and 4 parts pebbles or crushed stone. A sack of cement is equal to 1 cu. ft. If one sack of cement, 2 cu. ft. of sand, and 4 cu. ft. of gravel are used, a total of approximately 4.5 cu. ft. of concrete can be expected, not 7 cu. ft., since most of the sand and cement fills the voids between the larger particles. Waste and the size of the coarse aggregate cause some variation in the amount of finished concrete.

Following are proportions used for various concrete jobs:

1:1½:3 or 1:2:3—one-course roadways, walks, and floors; pavements; such watertight work as tanks, reservoirs, swimming pools, and cisterns; and such cast work as sewer pipe, drain tile, and fence posts.

1:2:4—general reinforced-concrete work, beams, columns, floors, and walls; work subjected to a moderate amount of water and dampness; bridges, engine foundations, and other work subjected to vibration; and silos, elevators, and coal bins.

1:2½:5—base courses for sidewalks, floors, and pavements; basement walls not required to be waterproof; foundations; mass dams; and retaining and wing walls of bridges and culverts.

1:3:6—mass construction, large footings, and large foundations.

POPULAR SCIENCE MONTHLY SHOP DATA



# Dams Turn Water into Kilowatts

**When you've figured out the power available and know where the water wheel is to go, it's time to start construction of the dam.**

## **Part Three**

**By C. D. Bussett**

**C**ONCRETE, though desirable, isn't necessary for damming a small stream. Beavers have gotten by for years without it. Suitable materials can be found on almost any farm. Logs, roughhewn timber, rock, masonry, planking, gravel, sand, and clay are all useful. Choose the materials most readily available on your property, or the least expensive if you must obtain them elsewhere.

You will have determined, on the basis of the first two installments of this series, the height and width of the dam you will need to convert your stream to power. The summer months provide an ideal time for its construction, for then most brooks are at their lowest level and the water will not impede the progress of the work.

Four basic types of small dams are shown in the accompanying drawings. All are adaptable in general to the kind of materials likely to be on hand and also to the head of power desired.

There are two basic principles of design to bear in mind no matter which you build. First, a dam should be sealed both above and below its foundation to prevent the seepage of water through or under it. Seepage through a dam, if permitted, weakens the structure and will eventually break it; that under a dam will undermine its foundation. Then, too, some means must be provided to prevent undermining of the dam by the water that flows or spills over it.

In addition, you should check with your local authorities and possibly file plans for your dam with them. States have widely varying regulations, some extremely lenient and some fairly strict. In most, general supervision comes under the State board of health, but a visit to your local county offices will give you correct guidance.

Figure 1 illustrates the earth dam, which blends well with its surroundings and hence is particularly suited where landscaping or scenic qualities are to be considered. Sealing this type of dam is most important since seepage will literally carry it away if allowed to progress. The seal is put in first and the dam built around it. How far down it should go depends upon the kind of soil. A sand foundation, for instance, requires the seal to extend deeper than clay. If planking is used, it would be well to apply a protective coat such as tar or creosote.

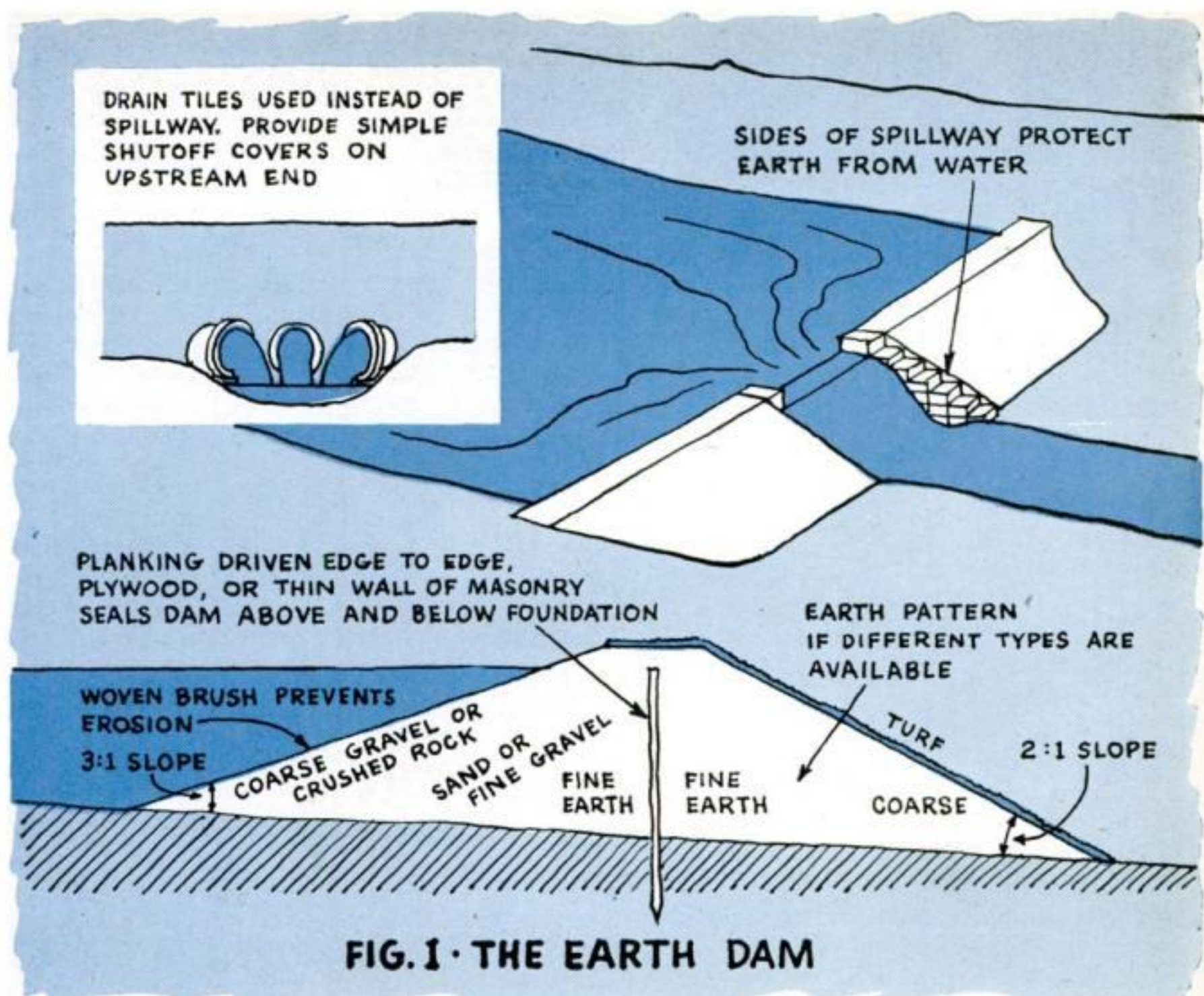
A general pattern for depositing the earth fill is shown in the drawing, but it is not necessary to follow it unless different types of earth are available. Deposit the fill by layers, rolling and tamping each layer well. Then protect the waterside surface from erosion by covering it with a matting woven from brush. Plant turf on the top and downstream side to hold the earth.

Such a dam obviously cannot have water spilling over its crest since this action would wash it away. Two suggestions for handling the excess water are shown. The spillway must be of some material, such as masonry or planking, resistant to the erosion of rushing water, and the sides must protect the open ends of the earth dam from spillage water. An alternative method of handling runoff water is with drain tiles instead of a spillway. Some means must be provided for shutting them off. A simple cover on the upstream end would serve.

Figure 2 shows the framed dam, which likewise can be easily built, particularly on a farm where lumber in any form from logs to planks is abundantly available. Each frame consists of one joist on which the surface timber is laid and one or more struts. Once the height of the dam is determined, the size of individual frames will vary depending on the contour of the gulley, those frames located at the lowest part being the largest. The frames are spaced according to the support the surface timber needs, that is, the thinner the surfacing the more supports.

Lay the planking surface or roughhewn timber horizontally and edge to edge across the frames, and bolt or spike each in place.





Calk the joints and apply a protective coating. Fill is put in behind the downstream side. Build the spillway entirely of planking or similar material.

The gravity dam, shown in Fig. 3, relies upon its weight for its stability. This dam would be most feasible where large rocks or field stones abound. Bricks, concrete or cinder blocks, and even chunks of broken concrete pavement are also excellent materials. The dam is strictly a masonry type, each block being laid with mortar.

Length is not a critical factor for any of these three dams, but it is important for the arch dam illustrated in Fig. 4. The placement of such a dam in a gulley is limited not only to the point of least width but also to the point where the banks are highest. Otherwise this dam would impound little water. It would seem unwise to build one to span more than a width of 10'. If the heavy timber is used only as a frame on which to spike or bolt a surface of planking, as shown in one of the drawings in Fig. 4, the number of timber arches will depend on

the strength of the planking and also on the height of the dam.

Only earth foundations are considered in the drawings, but you may be fortunate enough to have a solid rock foundation on which to build. In that case a seal below the foundation will not be necessary, but some means must be provided to anchor the dam to the rock, such as with anchor bolts in the case of either the framed or gravity dam. Likewise the dam should be sealed at the rock foundation to prevent seepage under it.

In most instances it will be found best to restrict the width of the spillway for excess water to some part of the total length of the dam. This will always be necessary in the case of an earth dam to prevent washing. The spillage water may be allowed to pour over the entire length of framed, gravity, and arch dams, however, if the precautions shown in Fig. 5 are taken.

If the downstream side of the dam, or of the spillway, is a curved hard surface of masonry or timber approximating the natural curvature of the water flowing over, it will



guide the spillage water so it will be directed downstream without actually falling. Such a curved spillway surface is particularly satisfactory for an earth dam. Large rocks, bricks, or other hard objects placed on the downstream side of a spillway not having a curved surface will break the force of the free-falling water and prevent erosion.

The spillway in its simplest form takes the shape of a rectangular depression in the crest of the dam. It should usually be large enough to carry off sufficient excess water so that impounded waters will not top the dam at any season of the year. This, of course, is quite a problem, since accurate determination of spillway capacity requires a knowledge of the total area drained by the creek being dammed plus data on the amount of rainfall at all seasons.

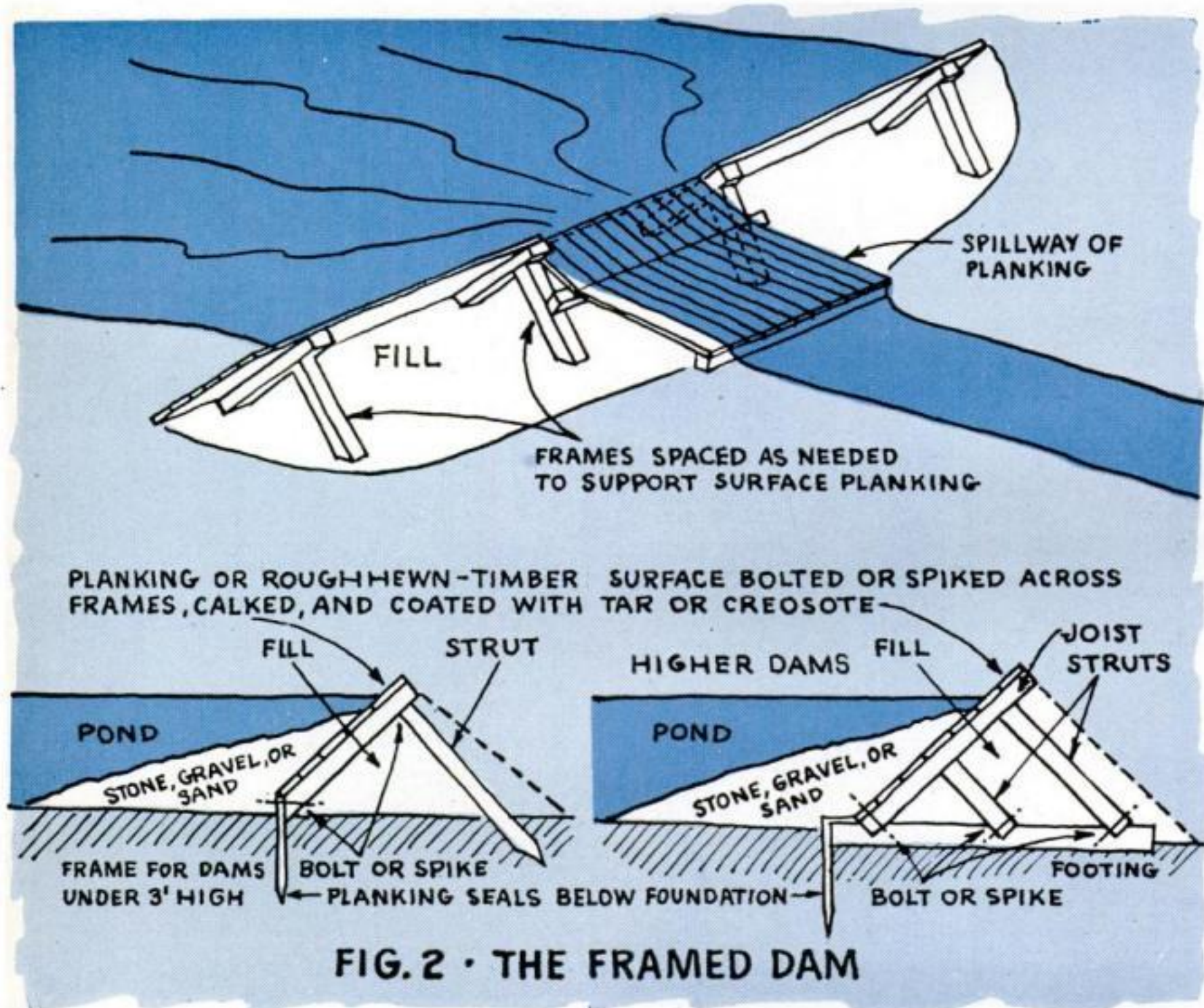
However, most of us will know whether or not the creek we are damming stays within its banks during the year. If it does, then a safe rule to apply would be to make the area of the spillway equal to the cross-section area of the creek at the dam when

it is brimful or just ready to flood. The formula is illustrated in Fig. 6.

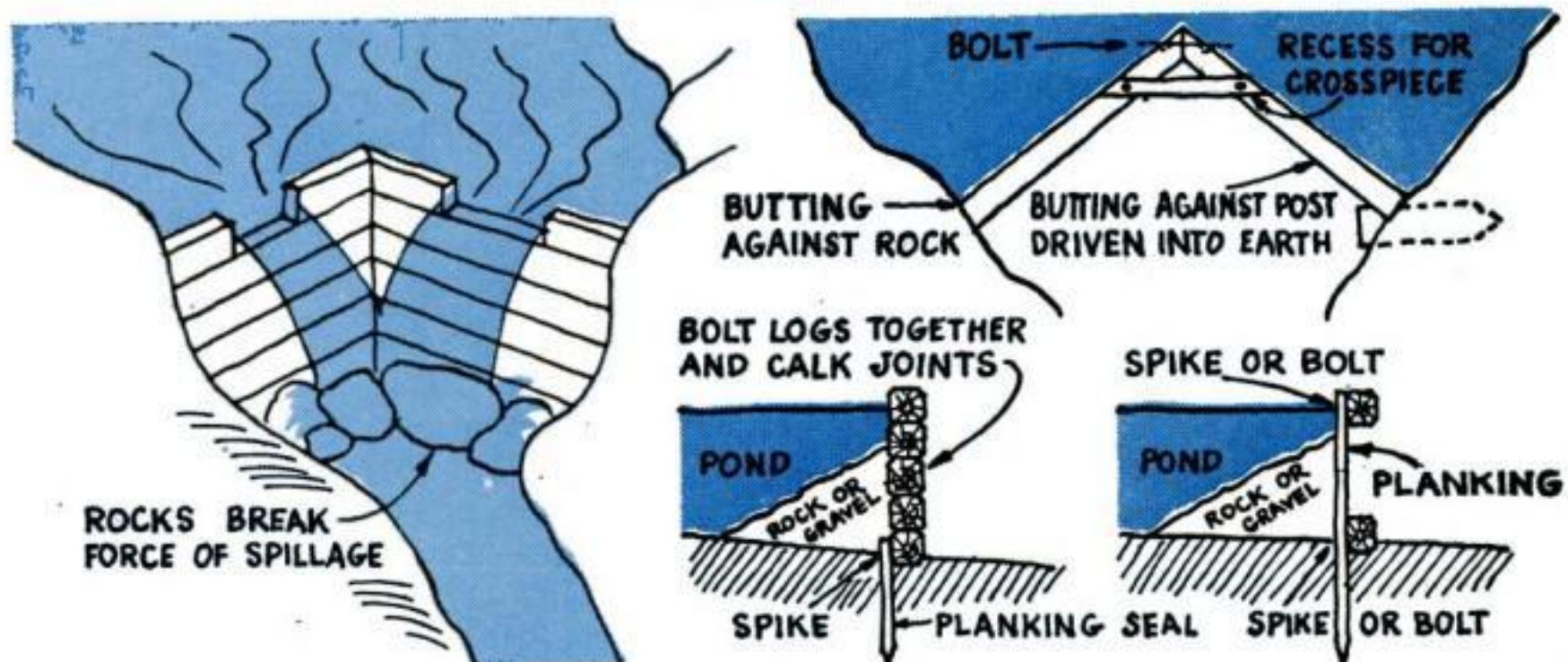
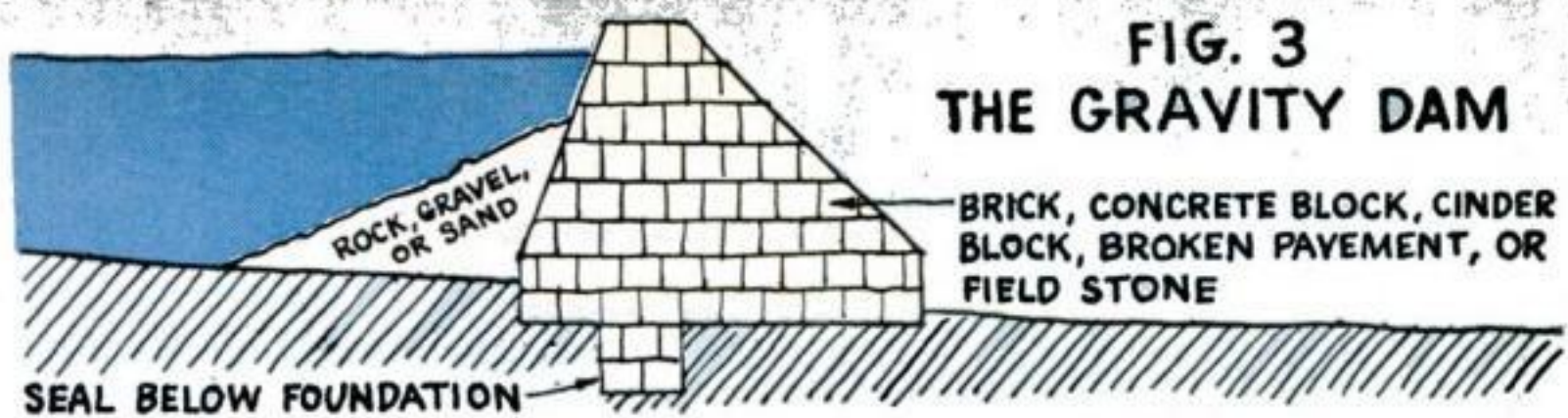
If the stream does flood, then either construct a dam that in an emergency can allow water to top its full length or build some sort of floodgate into the dam so it can be opened when necessary. One form such a floodgate could take is a group of drain tiles through the dam, as shown in Fig. 1.

The height of the dam you build will be determined by the area of the land to be covered by the impounded water. In general, the higher the dam, the greater the area covered by water above it.

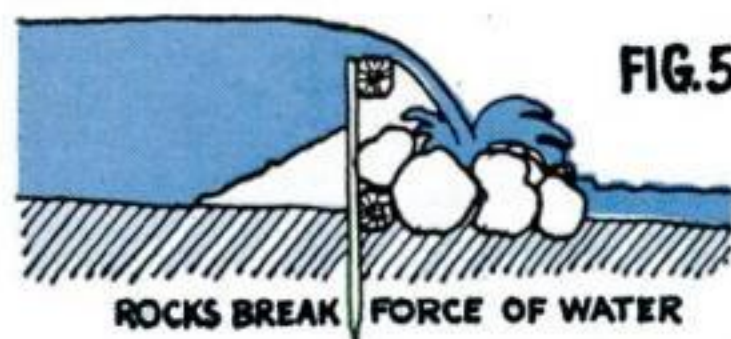
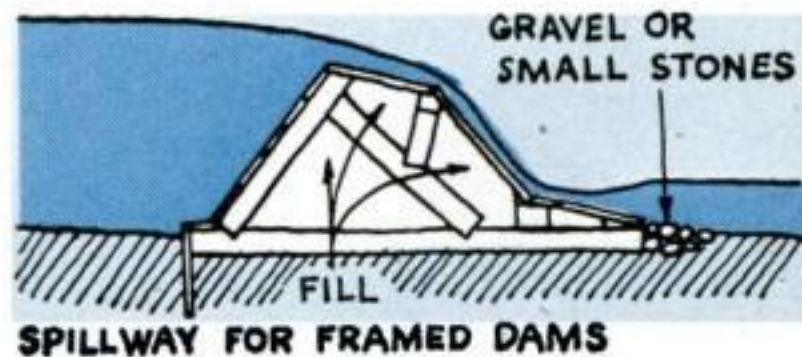
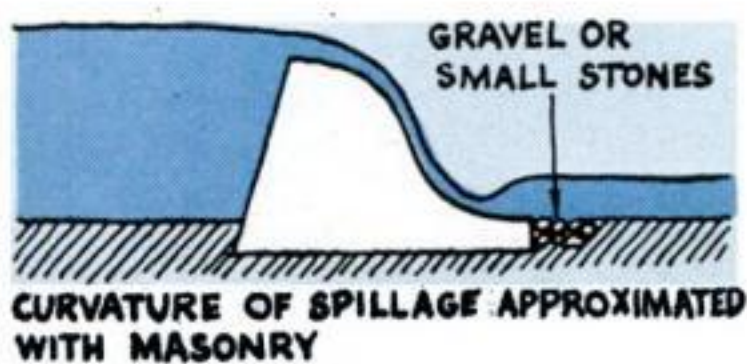
All vegetation, brush, floatage, and the like in the area to be flooded and for about 15' around it should be burned out or otherwise cleared before the dam is built. This keeps down the breeding of mosquitoes and helps retard pollution. It is required in the regulations of some States and is a wise precaution even when not covered by law. In addition, all trees in the area to be flooded should be cut reasonably close to the ground. TO BE CONTINUED







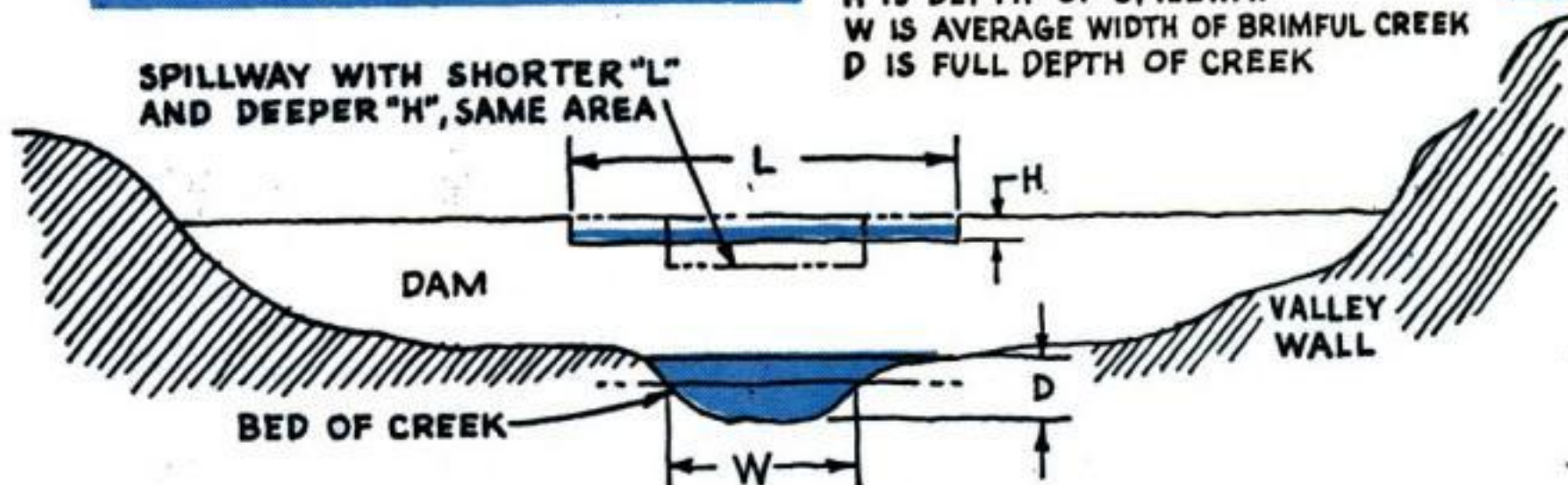
**FIG. 4 • THE ARCH DAM**



**FIG. 5 • METHODS OF PREVENTING SPILLAGE WATER FROM UNDERMINING DAM**

SPILLWAY WITH SHORTER "L" AND DEEPER "H", SAME AREA

$L \times H = W \times D$   
L IS LENGTH OF SPILLWAY  
H IS DEPTH OF SPILLWAY  
W IS AVERAGE WIDTH OF BRIMFUL CREEK  
D IS FULL DEPTH OF CREEK



**FIG. 6 • DETERMINING THE SIZE OF SPILLWAY**



# More Power to You

*Here are three designs for D.C. power supplies that will furnish rectified voltages for receivers, transmitters, test equipment, and other uses.*

**S**MALL power supplies capable of furnishing filtered and reasonably pure direct current always have a place on the experimenter's workbench. For some equipment, of course, power packs must be designed to give specific currents and voltages, but for the majority of applications one or more of the three units described here can be used. They will conserve battery life in portable apparatus, balance a Wheatstone bridge, extend the range of an ohmmeter, or provide bias or power voltage for experimental amplifiers, receivers, and transmitters.

Dry-disk rectifiers, recently made available to experimenters, replace rectifier tubes in many circuits. The selenium disks require only two soldered connections. They have no filaments and therefore require no separate filament supply. Because of their rugged metallic construction they are also able to withstand a lot of knocks. Two of the three circuits given below employ these new rectifiers; all three are made of easily obtainable and standard parts.

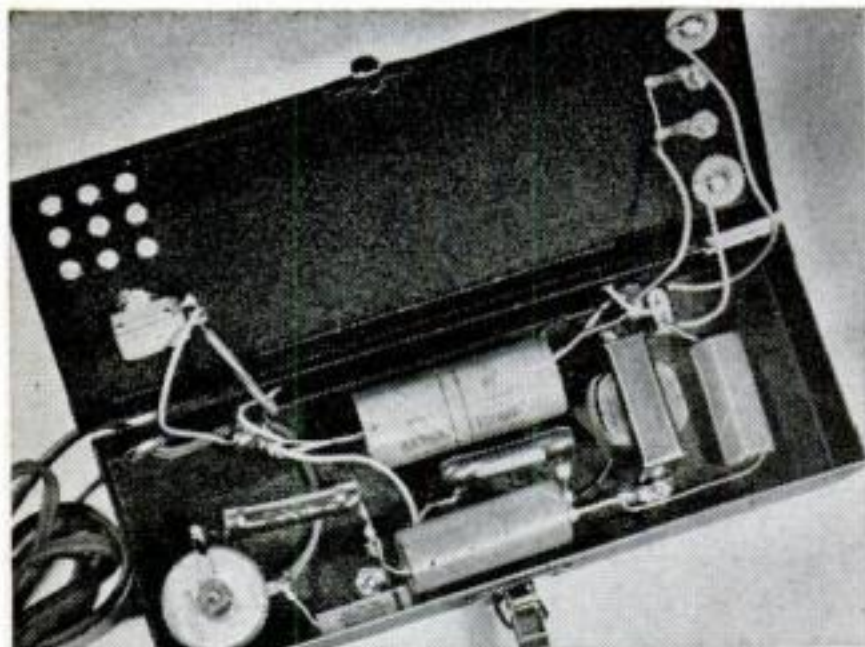
Selenium rectifiers are color-coded to in-

dicate polarity. The positive side, indicated by a red dot or some similar marking, is equivalent to the cathode of a rectifier tube; the negative side, marked with black, functions as the plate. The position of the red dot in relation to the other circuit elements is shown in the diagrams.

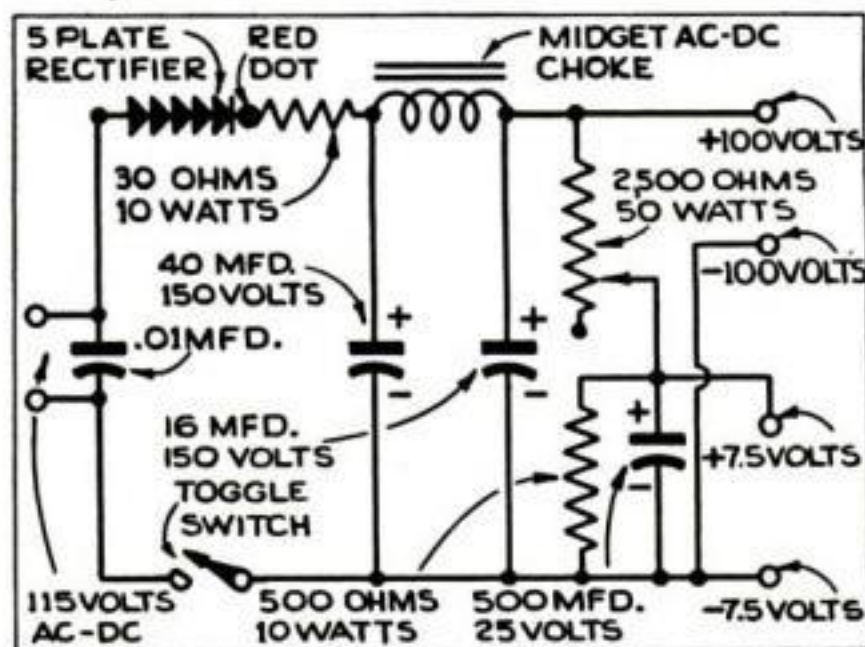
## Battery Eliminator

The dry-disk battery eliminator shown on these two pages was built by Frank Tobin as a companion piece for his three-tube superheterodyne receiver (PSM, April '47). It is shaped to fit the battery compartment of his and other radios and can be used with practically any receiver that requires approximately 90 and 7.5 volts of B and A supply respectively.

In order to use the eliminator with the three-tube receiver, it is necessary to connect the tubes in series so that the current drain will not exceed 50 ma. Many battery tubes have their filaments arranged so that they may be connected either in series or in parallel. As originally built, the set placed all the tubes in parallel to operate on a 1.5-volt battery. The diagram on the facing page shows the changes that must be made if the set is to run on the higher filament voltage. Simply putting the tubes in series without modifying the associated circuit shown by the blue lines would also have the effect of raising the A.V.C. voltage to 7.5 volts—equal to the sum of the tube voltages. In

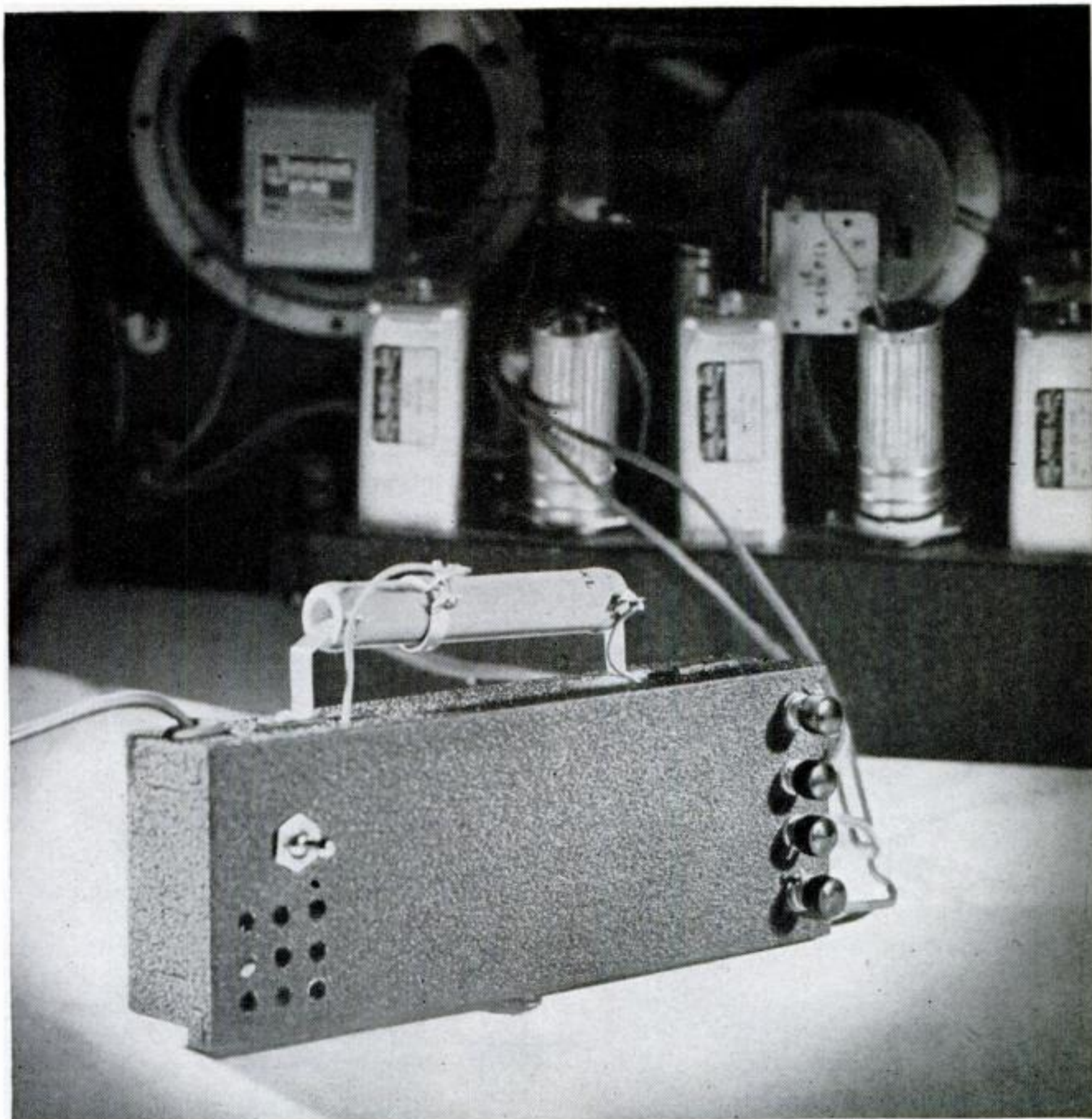


An oblong metal tool box that will fit readily into the battery compartment of most receivers is both the chassis and cabinet of this power supply.

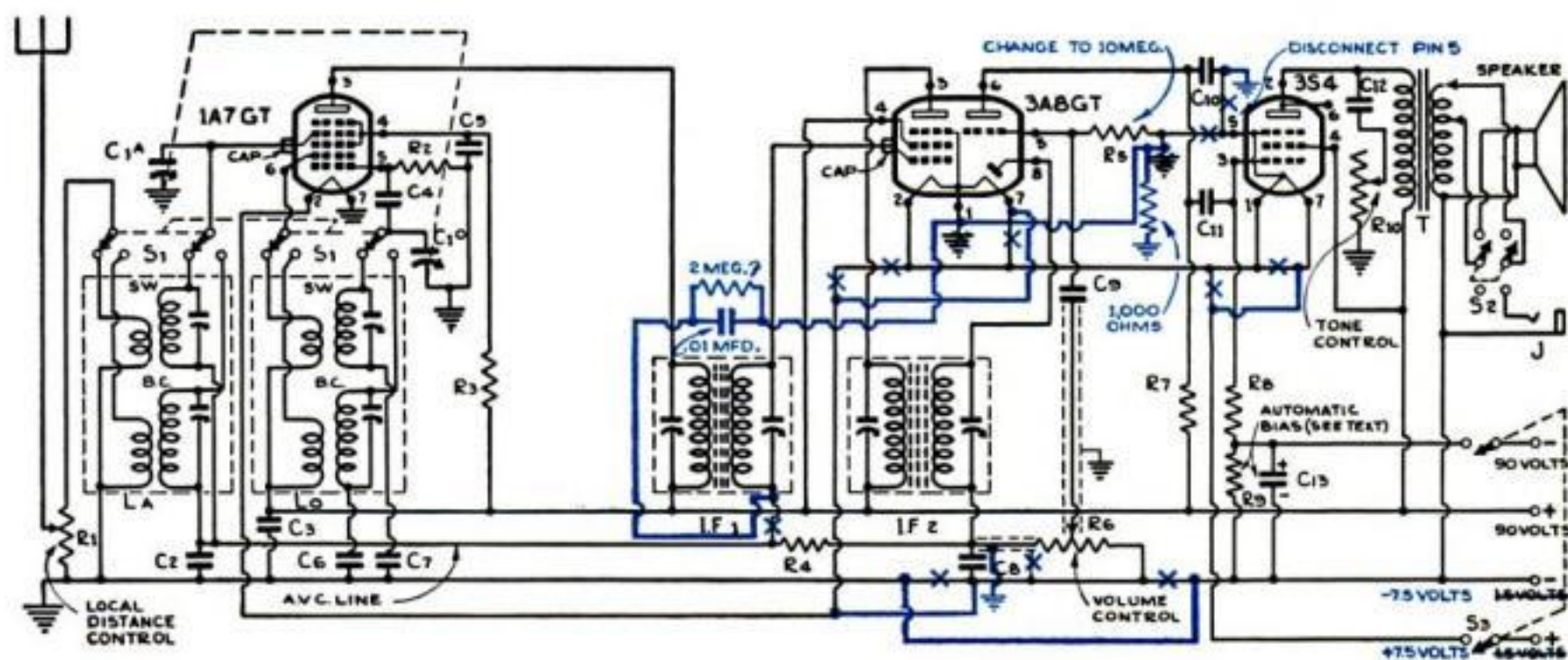


The parts used in this simple rectifier unit may be purchased for a couple of dollars. They will save many times their cost in battery replacements.





When used with the rectifier, the superhet circuit must be altered as shown by the modified diagram, below.

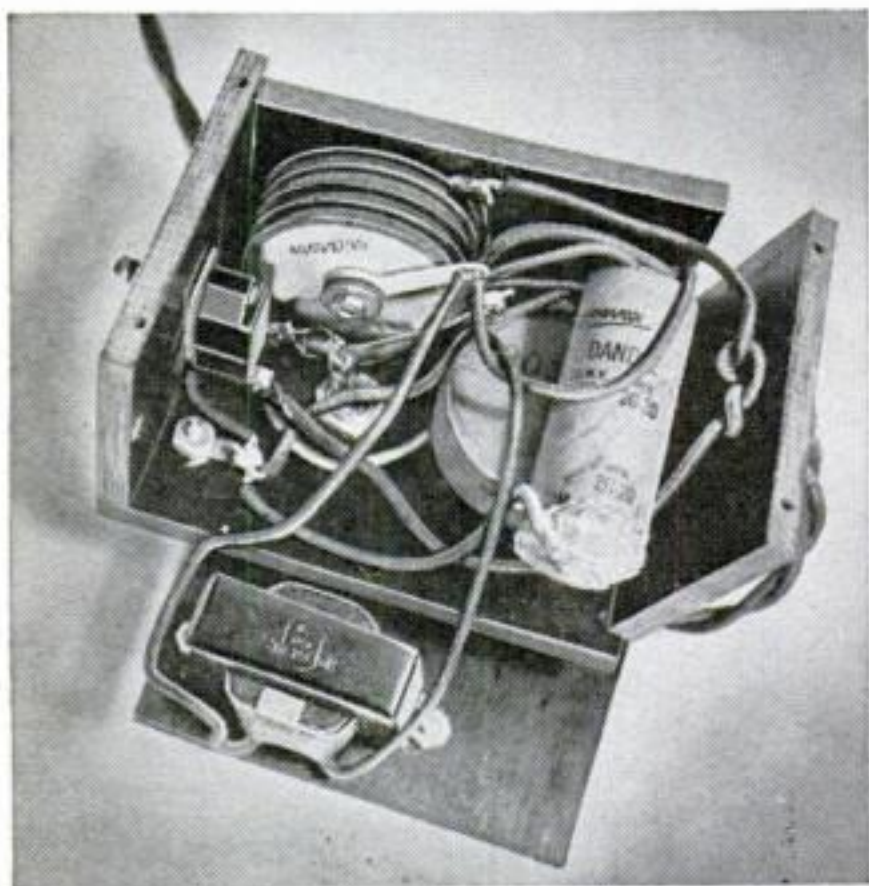


New connections in the filament circuit are indicated by added blue lines; remove leads marked with an X.

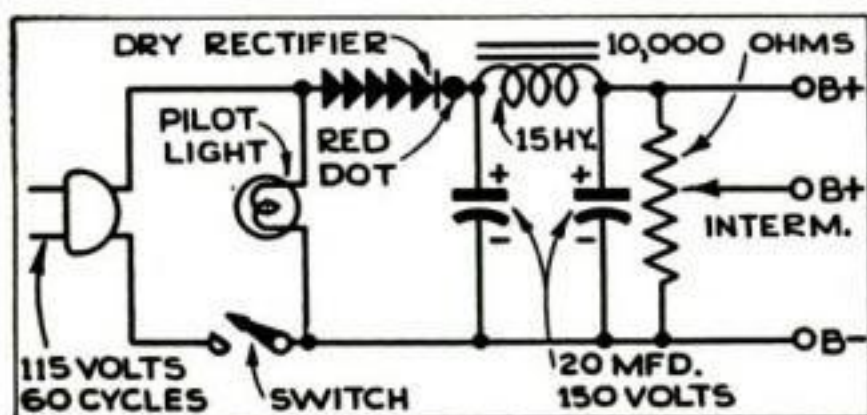




A small bakelite box houses the midget rectifier. The voltage control, pilot light, and output jacks are conveniently placed on top of the cabinet.



Position of the parts is not critical but it is desirable to allow as much space and ventilation as possible around the dry-disk rectifier stack.



Output of this power supply is variable from 70 to 140 volts. If the ripple is objectionable, increase the size of the first condenser to 40 mfd.

other words, the set would have to receive a signal of 7.5 volts before it could operate. Since received signals are generally on the order of microvolts, it is evident that no sound will reach the loudspeaker unless these other changes are made. The alterations in the circuit, indicated by the blue lines in the diagram, should not take more than half an hour to accomplish.

Because a considerable amount of heat is dissipated through the 2,500-ohm dropping resistor, a unit with a rated value of 50 watts was selected. The high wattage gives a safe margin against overheating, but a 25-watt resistor of equal ohmage may be substituted provided that it is used outside the cabinet and is otherwise well ventilated. The variable tap on this resistor allows for accurate adjustment of the A voltage.

A small metal tool box is used as both chassis and cabinet of the battery eliminator. The metal box also serves as a shield around the rectifier, cutting down the induced hum. Holes are drilled in the cover just above the dry-disk rectifier to provide the necessary ventilation. The wire-wound resistor is placed outside the box.

#### *Midget Power Pack*

In the operation of battery radios, the major item of cost is the B battery. Regardless of filament requirements, therefore, an appreciable saving can be made by using a rectifier for the B supply whenever house current is available. This midget power supply, made by R. L. Parmenter, provides such a variable B voltage and can be used in conjunction with a dry-cell A supply. Output is variable from 75 to 140 volts. As can be seen from the photos, the complete assembly is hardly larger than a cigarette package.

A bakelite box was fabricated from  $\frac{1}{4}$ " stock and has inside dimensions of 2" by 2 $\frac{3}{8}$ " by 3 $\frac{1}{2}$ ". Placement of parts is not critical, but it is desirable to leave as much "breathing space" as possible around the rectifier. The 10,000-ohm wire-wound potentiometer which is used as a voltage divider to vary the output potential is mounted on the top panel. Also on this panel are the pilot light and the banana jacks to which the output leads may be connected. The pilot light consists of a midget fuse indicator cemented into a ruby jewel. The limiting resistor that comes with such a light should be left attached and wired into the circuit. A  $\frac{1}{4}$ -watt neon bulb may be even more satisfactory for this purpose.



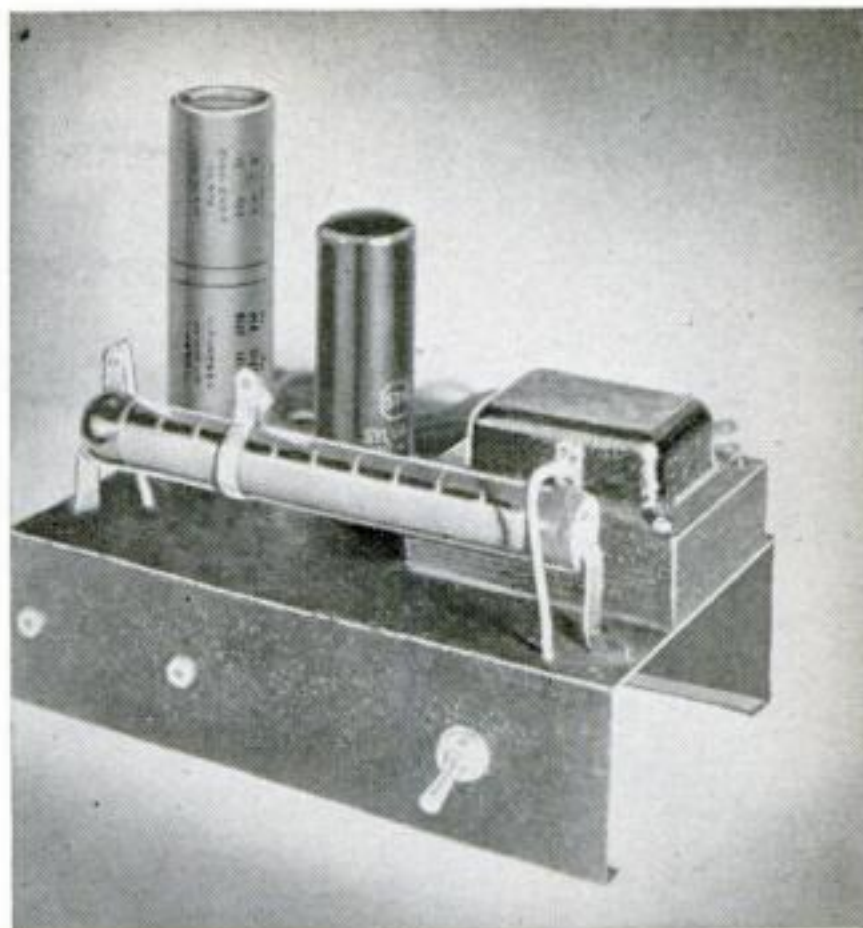
Limits on the amount of current that can be passed by a power supply circuit are set by the rectifier that is selected. The dry disks are available in several current ratings from 75 to 200 ma.; 100 ma. is adequate for most uses to which the supply is likely to be put. To eliminate the ripple that is present after half-wave rectification, a filter choke must be used in conjunction with at least one, and preferably two, filter condensers. The larger the capacity of the input condenser, the higher the output voltage. Also, within certain limits, higher capacity usually results in better filtering. A choke capable of handling from 70 to 100 ma. is desirable in order to make the most efficient use of the rectifier.

The imaginative builder will find many applications for this power supply. Used to provide plate potential for small short-wave regenerative receivers, the variable resistor acts as an auxiliary regeneration control. If the device is to be used with a volt-ohmmeter to increase the range of resistance readings, it may be worthwhile to incorporate some method for checking the available voltage. A voltmeter of 1,000-ohms-per-volt sensitivity connected across the terminals through a switch will allow for continuous checking of the booster voltage.

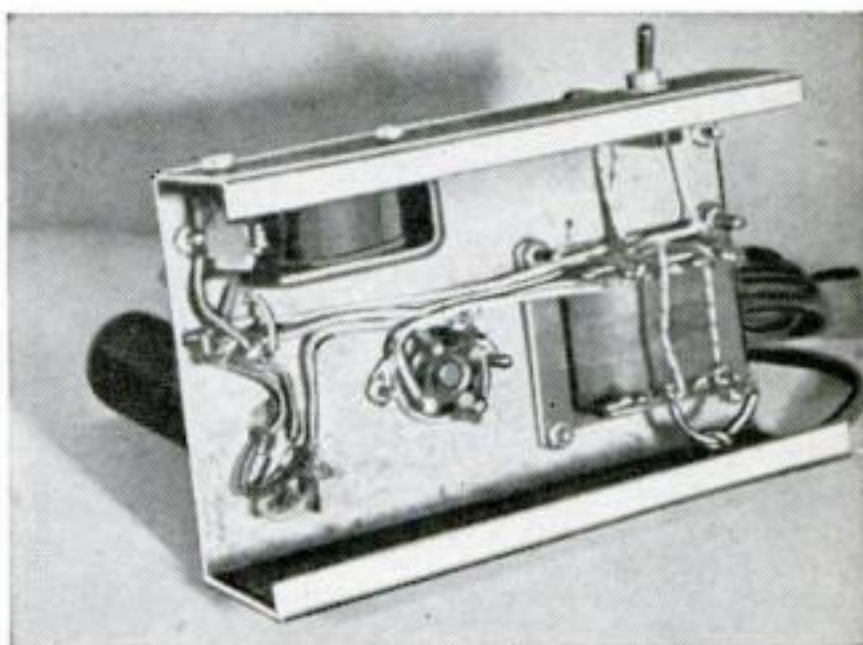
#### 400-Volt Supply

Carl Andresen built this third power supply from his spare-parts box; most of the necessary components can probably be found in the average electrical or radio home workshop. A 2" by 4" by 8" sheet-metal chassis painted with a dark wrinkle-finish enamel was used. Neither the chassis size nor the position of the parts is critical.

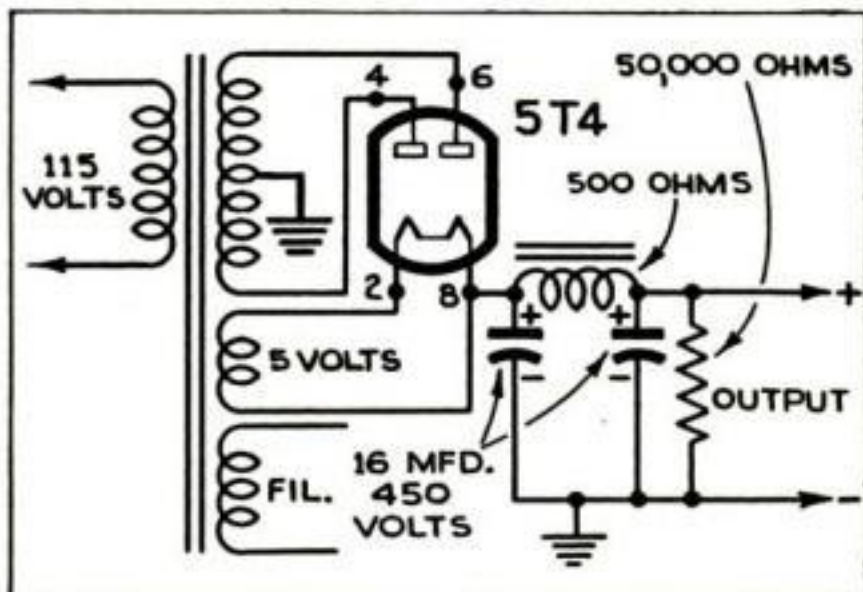
The power transformer, which came out of an old radio, has a high-voltage winding of approximately 500 volts with 250 volts at the center tap. It also has two filament windings, of which only the 5-volt section is used. The 5T4 tube was chosen because it happened to be handy; several other full-wave rectifiers would work as well. For the filter choke the author removed a 500-ohm field coil from a small speaker; the coil and a dual 16-16 mfd., 450-volt electrolytic condenser make up the filter system. A 50,000-ohm, 50-watt bleeder resistance is put across the output to improve voltage regulation. Different voltages may be tapped off the adjustable slide of this resistor. Plugged into a 115-volt 60-cycle line, it should deliver about 400 volts of ripple-free D.C.



The power transformer, full-wave rectifier, dual electrolytic, and bleeder resistor are mounted on top of the 2" by 4" by 8" sheet-metal chassis.



Wiring is done on the underside of the chassis of the 400-volt power supply. The 500-ohm field coil used as a filter choke is also mounted underneath.

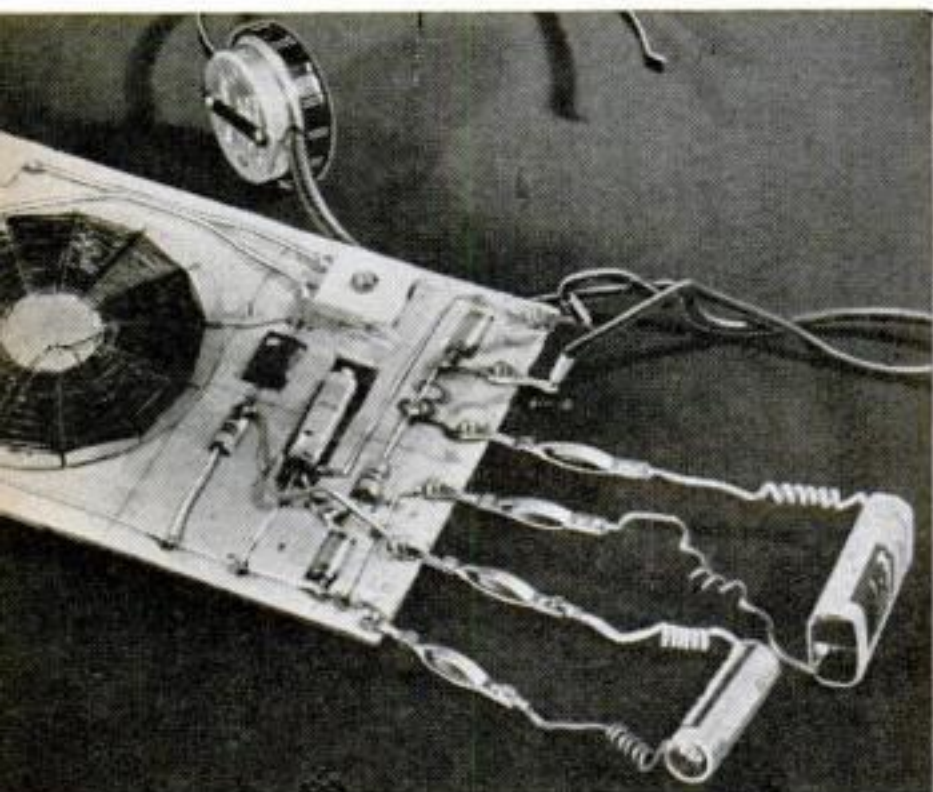


One of the filament windings of the power transformer is left unconnected. The switch shown in the photos is inserted in the transformer primary.

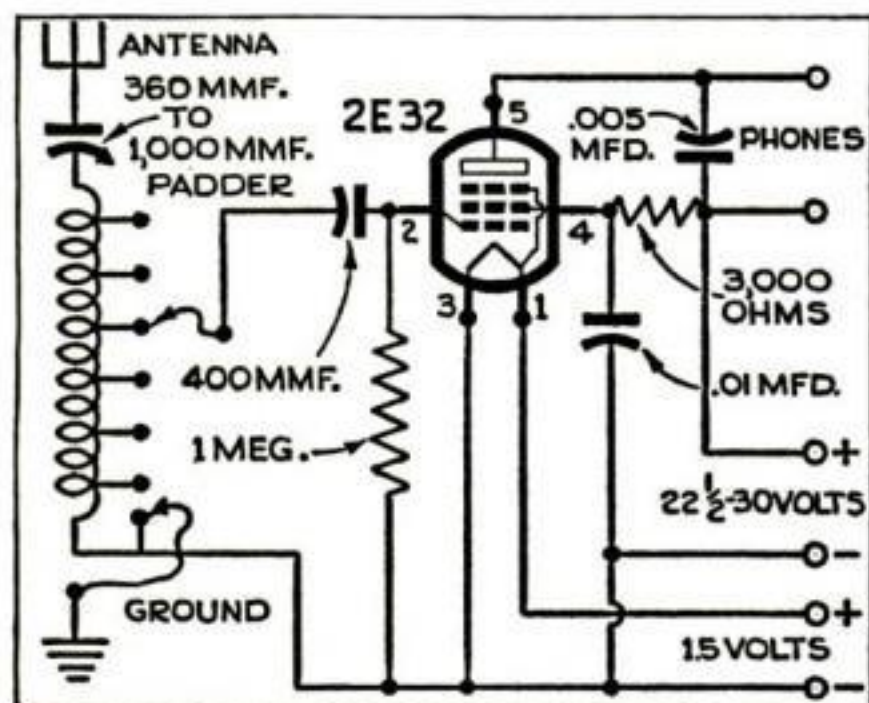




Fitting parts into slots in the cardboard chassis makes the set flat and also guards the components.



Small crocodile clips soldered to the various detachable leads permit quick and easy connection.



Resistors are  $\frac{1}{4}$  watt, and the tubular condensers 200 volts; phone impedance should be 2,000 ohms.

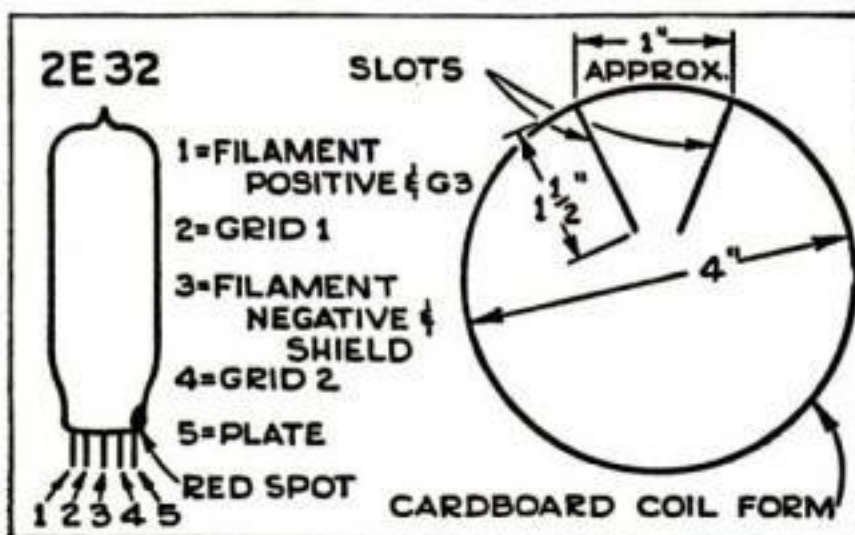
## One-Tube Radio Can Be Mailed

**S**UBMINIATURE tubes measuring less than  $\frac{1}{4}$ " in diameter will make it possible to redesign radio circuits to almost any shape and size. This novelty receiver is as flat as the tube itself and can therefore be inserted in a 6" by 9" envelope and sent through the mails as a letter. The two pieces of  $\frac{1}{8}$ " cardboard that form the chassis are held together by the same nuts and bolts that hold the phone, battery, antenna and ground terminals in place. Slots are cut in the cardboard to clear the components.

The tiny 2E32 tube is a shielded pentode and operates with a plate voltage of  $22\frac{1}{2}$  and a filament voltage of  $1\frac{1}{4}$ . For the latter, a small flashlight cell will give several hours of useful life. One of the miniature  $22\frac{1}{2}$ - or 30-volt batteries will supply both the plate and the screen.

To keep the receiver flat, the coil is wound on a cardboard disk 4" in diameter. Cut 13 slots at intervals of approximately 1" as shown in the sketch below; then interlace the form with 92 turns of No. 30 enameled wire. At every twelfth turn, make a tap by scraping the enamel and letting a drop of solder adhere to the spot.

Although the circuit doesn't employ regeneration, it has sufficient power to pull in local stations. By selecting the right antenna and ground taps and adjusting the trimmer in the antenna lead, it should be possible to cover the entire broadcast band. The trimmer specified in the drawing is intended for use with a short indoor antenna; if used with a long antenna, a trimmer of lower capacity—say 125 to 350 mmf.—should be substituted.—ALBERT ROWLEY.

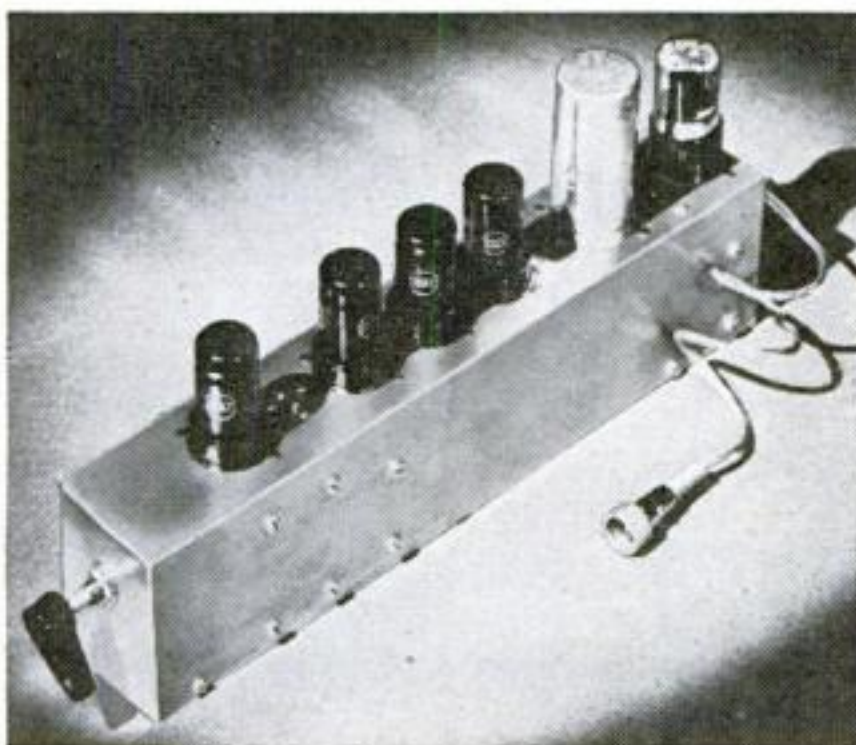


Tube leads may be identified by the position of the red spot. The coil is wound on a cardboard circle.





**NOISE SUPPRESSOR.** Radio and phonograph tone controls generally operate by cutting out the frequencies where noise is most prevalent. While they eliminate some noise, they also chop off important parts of the music. Unlike most filters, the circuit invented by H. H. Scott, president of Technology Instrument Corporation, of Waltham, Mass., discriminates against noise without appreciably affecting the desired sound. Gritty background "hash," common on old and worn records, is almost completely eliminated, and high-fidelity recordings come through with a range and quality surprising even to owners of the best previous equipment. The company makes an elaborate model for broadcasting stations; it also licenses the manufacture of smaller units for home use. One such device, pictured below, is made by the Fisher Radio Corporation, of New York, for installation in its radio-phonograph combinations.



## NEWS IN ELECTRONICS



**RING TUNER.** This complete variable tuner is intended to replace the coil-condenser combination in short-wave receivers, wave meters, low-power transmitters, and the like. Used with a tube whose capacity is 3.5 micromicrofarads, the tuner covers the 140-160 mc. band. It is made by the Clarkstan Corp., of Los Angeles.



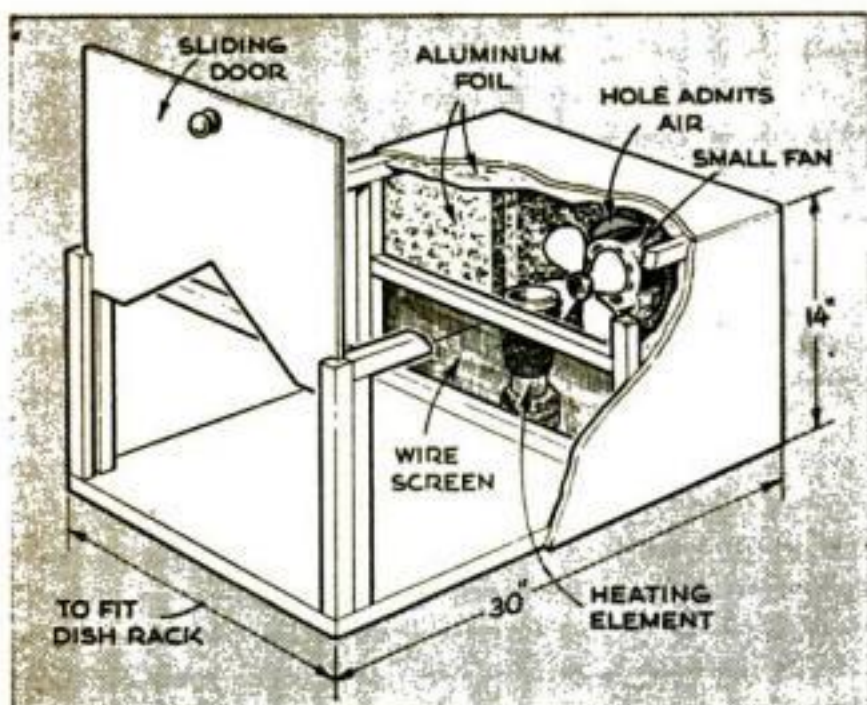
**NEEDLE-PRESSURE GAUGE.** Another Clarkstan product is the needle gauge shown above. It enables repairmen and technicians to measure accurately the pressure of a pick-up needle on a phonograph record. The price of the gauge is \$3.



**EYE-ANGLE RADIO.** Twisting the knurled front rim of the rack on which Hallicrafters' SX-42 receiver stands tilts the set up or down. By making the dials more readable, the accessory increases both comfort and tuning accuracy.

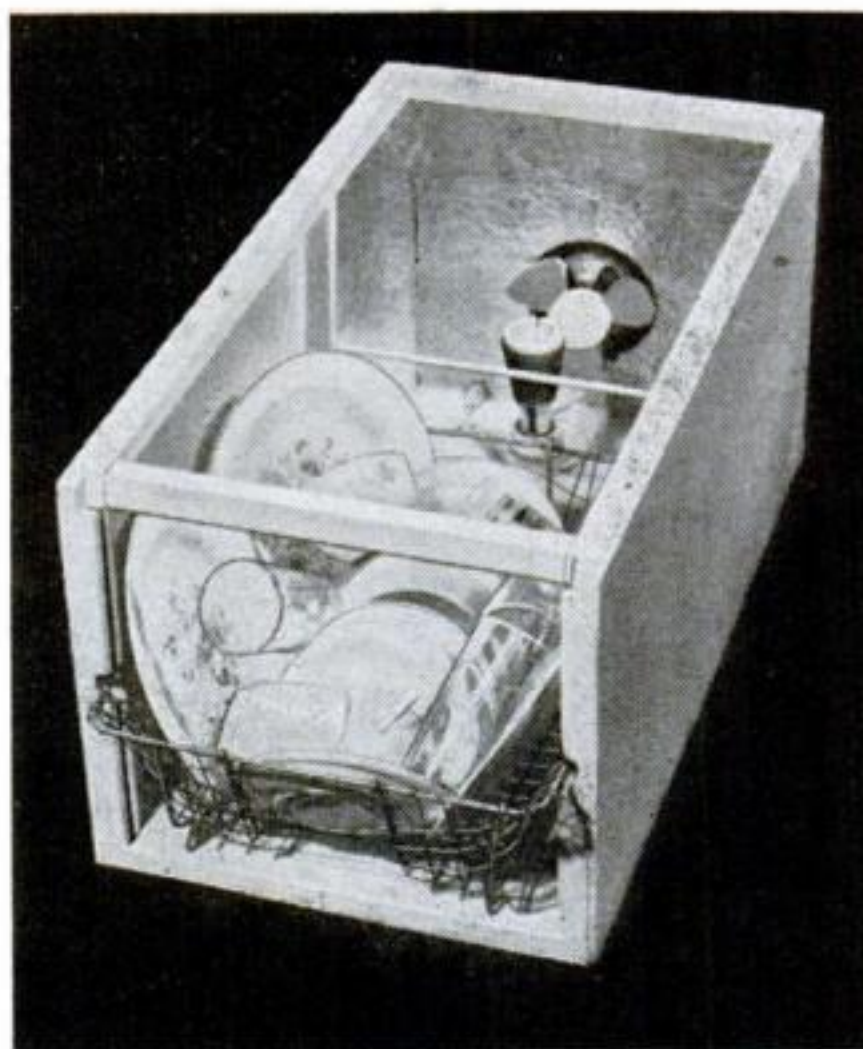


## Homemade Electrical Device Dries Dishes and Glasses Speedily

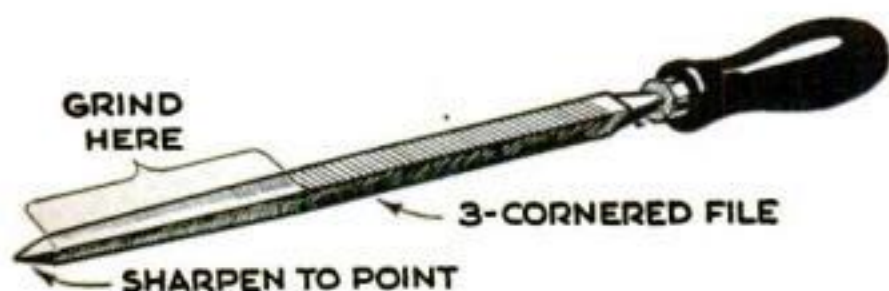


HEATED air from a 600-watt resistance element is blown over wet dishes in this device, which practically eliminates the need for a dish towel in the kitchen. In tests, dishes and glassware rinsed in water at 115 deg., which normally required up to 45 min. for air-drying, were completely dried in about 7 min.

The dryer consists of a box of hard composition board with pine framing, proportioned to take a standard dish rack. A circular hole in the rear and a notch in the sliding front permit the passage of air. The heating element and small fan are wired in parallel and controlled by a switch. Alumi-



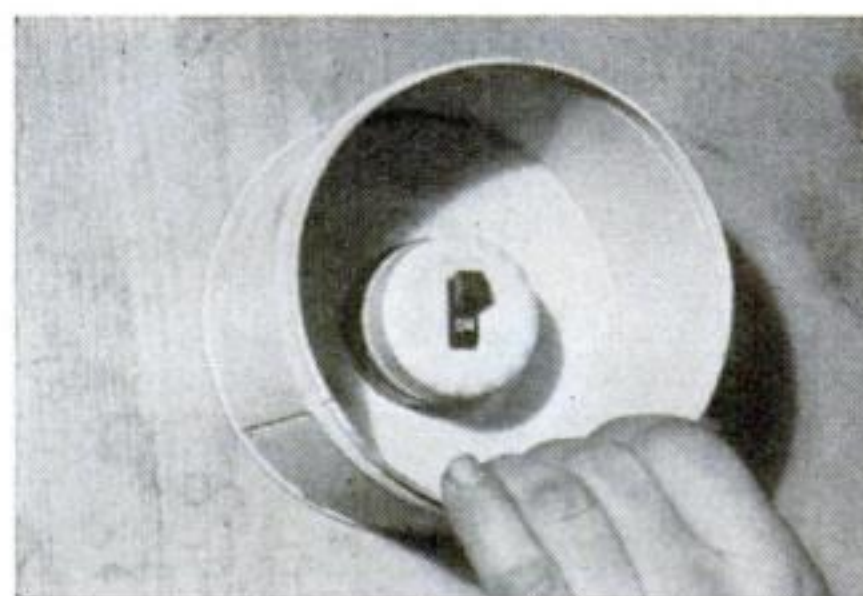
num foil is placed on the interior near the resistance unit, and a wire screen acts as a stop for the dish rack. Take every precaution to guard against shock: use only rubber-covered wire, and tape securely or otherwise protect all connections. Don't use a switch, but control the device by plugging in a heavy-duty plug.—G. S. GARDNER.



## File Makes Insulation Scraper

A HANDY insulation scraper for the radio and electrical worker's bench may be made from a worn triangular file. Grind off all teeth from the three sides for a distance of about 3", holding it against the wheel in such a way as to leave a slightly concave face on each side. The edges produced will be quite sharp but may be whetted on a small handstone for still greater keenness. If in addition the tip is ground to a tapering point, the tool will be useful for starting woodscrews and for enlarging and burring small holes that have been drilled or punched in sheet metal.—HERBERT SPOHN.

210 POPULAR SCIENCE



## Can Protects Outdoor Switch

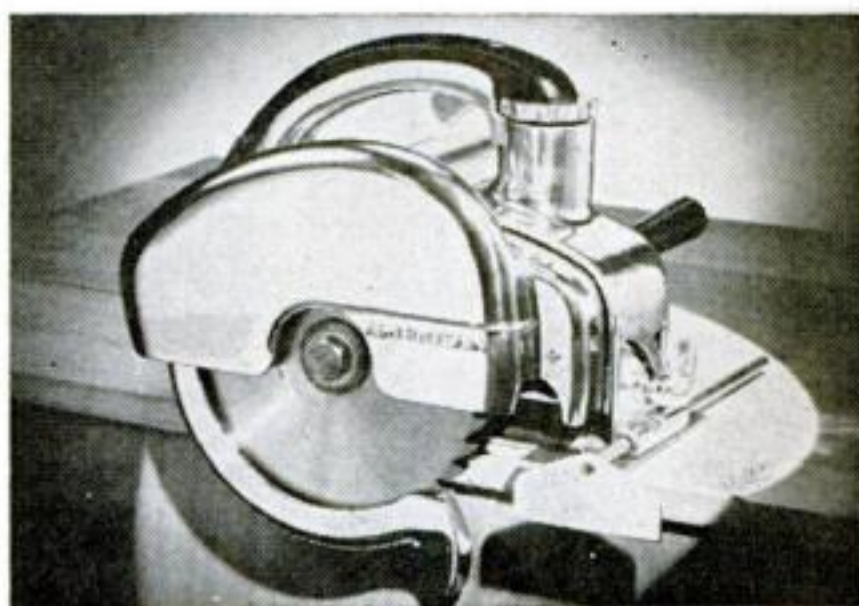
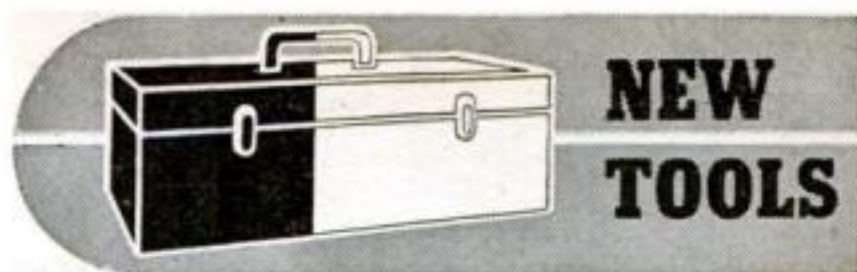
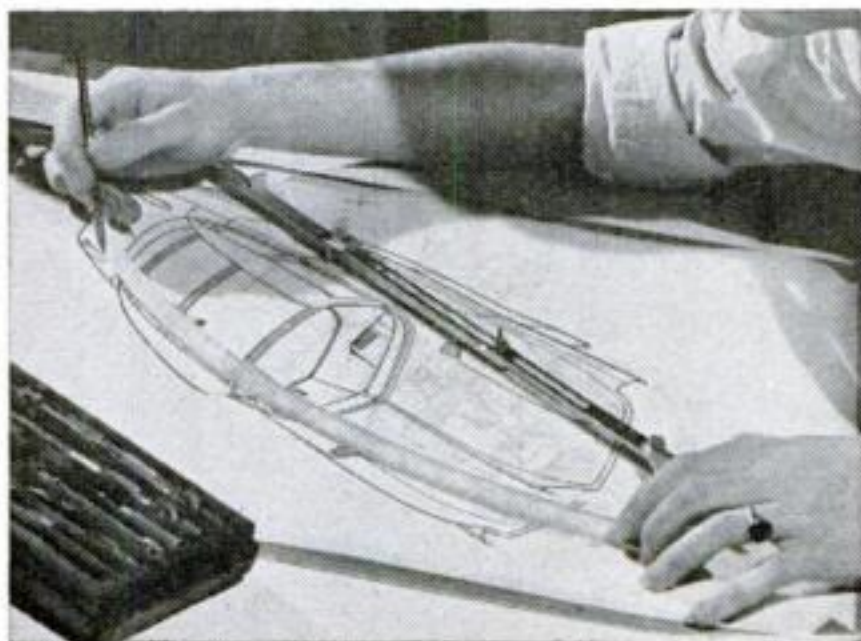
GARAGE and outbuilding switches that are directly exposed to the weather or are on porches or similar locations that rain may reach can be protected with old coffee cans. Use the kind with a screw-on lid, and paint well to prevent rusting. The switch is mounted and wired through holes punched in the can bottom.—IVAN GROSVENOR.





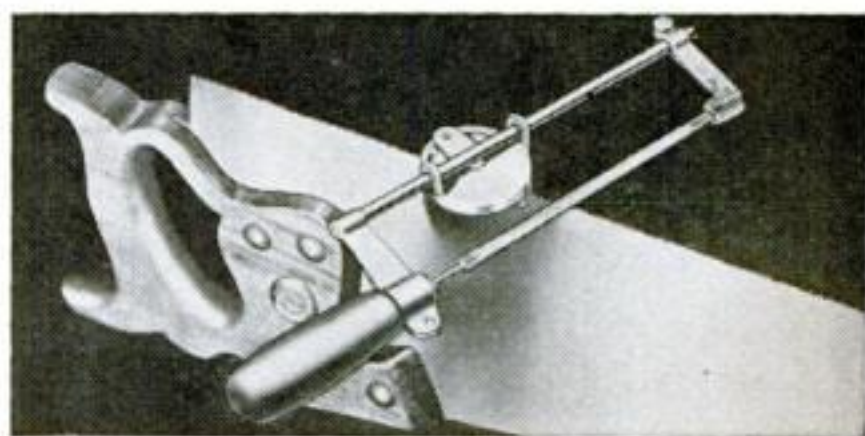
**PORTABLE ELECTRIC SAW.** This new product of the American Floor Surfacing Machine Co., of Toledo, Ohio, has an 8" blade driven by a 1½-hp. motor. Its free-running speed is 6,500 r.p.m. A screw-thread adjust-

**ANGLE VISE.** An all-angle vise suitable for die, gauge, and fixture drilling, also for grinding, is supplied by the Machinist Tool Company, of Chicago. It can be used on machine tools as well as on the bench. Hardened and ground jaws are available in both parallel and V-grooved types. The vise has a 2¾" lateral clearance, swivels 360 deg. on its base, and has a 90-deg. vertical angle adjustment.



ment regulates depth of cut to a maximum, for a straight cut, of 2¾". Although it is designed for one-hand operation, a second handle is provided as a convenience in vertical sawing.

**SAW FILER.** An attachment that will enable home craftsmen to sharpen saws quickly and accurately is made by the Speed Corp., of Portland, Ore. The tool locks into position on the saw, as shown in the photo below, and automatically guides the file. Two adjustments adapt the device to any type of hand saw.



**FOR DRAWING CURVES.** Adjustable for a wide range of arcs and irregular curves, this drafting instrument, which comes in 1½' and 2' sizes, will form arcs from infinite radius down to 10" and 1' respectively. It is particularly useful for drawing arcs of very large radius where the center of a beam compass falls outside the drafting table. Albert G. Daniels, of Winnsboro, S. C., makes the device.



# Vacuum Cleaner

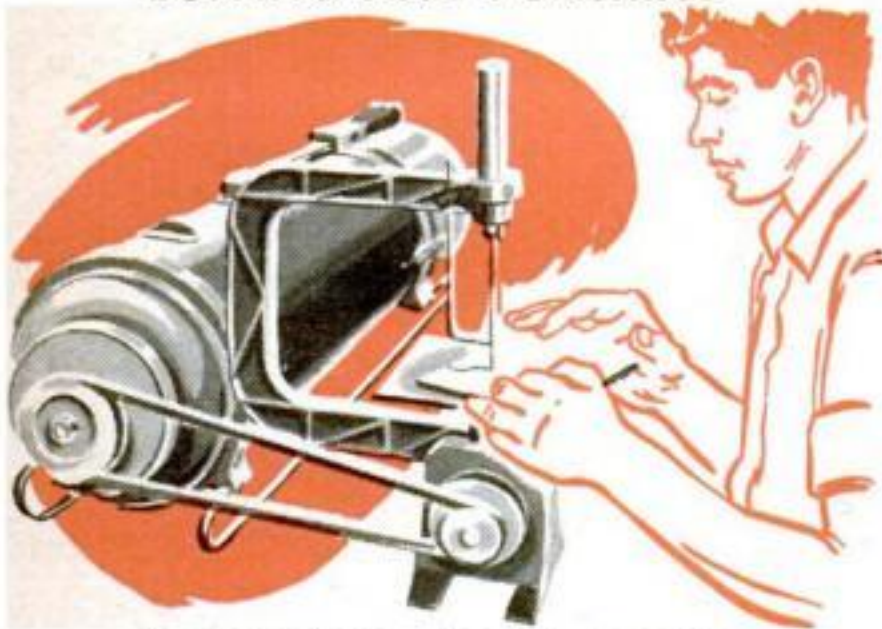
**By Harold P. Strand**



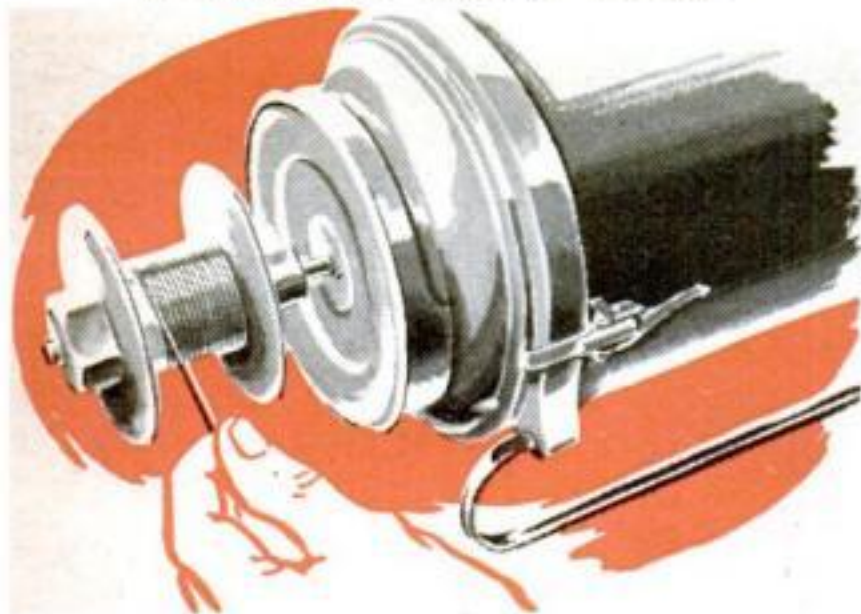
**FLEXIBLE-SHAFT CARVING**



**BUFFING AND POLISHING**



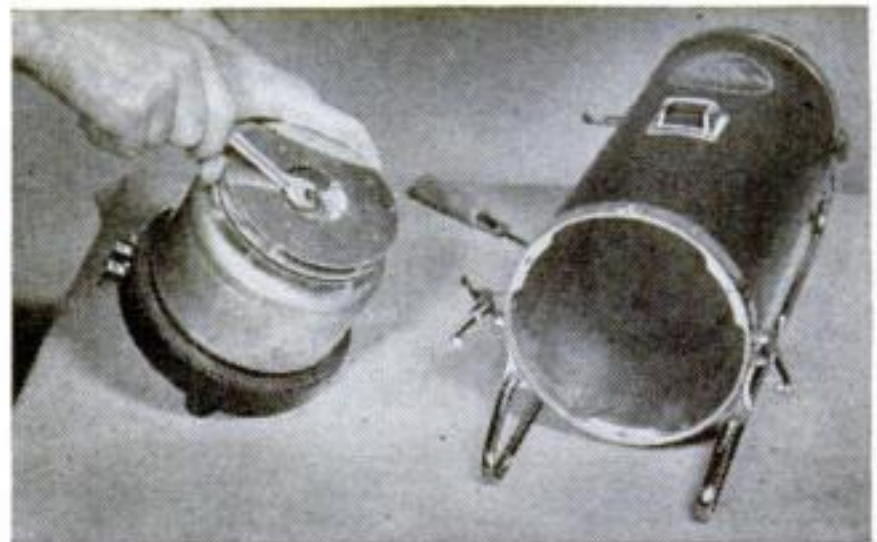
**POWERING SMALL TOOLS**



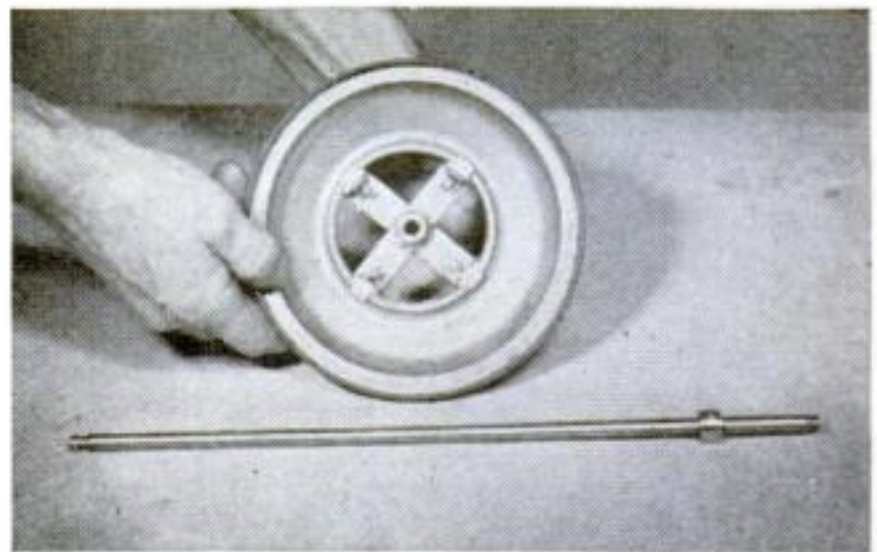
**WINDING COILS**

**Y**OUR tank-type vacuum cleaner can be converted into a versatile power unit with numerous uses in both kitchen and workshop. Fitted with an extension shaft and arbor, it will take a small grinding wheel for sharpening knives or tools, or a buffing wheel for polishing household silver and metal craftwork. Depending on your equipment and needs, it will also lend itself to many other tasks—driving a flexible-shaft carving tool, for example, or operating light-duty power tools such as a jeweler's lathe or jigsaw.

Conversion doesn't impair the usefulness of the cleaner; the extension shaft may be speedily removed when cleaning is to be done. One end of the shaft fits into a special stud that replaces the original fan-retaining nut, and the other end extends through a bearing on the suction end of the tank. This



Keeping the fans from turning with your left hand, unscrew and discard the original fan-retaining nut.



Rear view of the modified cover. The collar on the shaft is so located as to keep the pin in the stud.



# Doubles as a Power Tool

bearing is held in the aluminum cover cap in such a way that it can be removed without damage to the cap; but for convenience in changing between power and cleaning applications, a second end cap can be obtained from a vacuum-cleaner repair shop. With this spare cap, you'll be able to switch between types of duty in a matter of seconds.

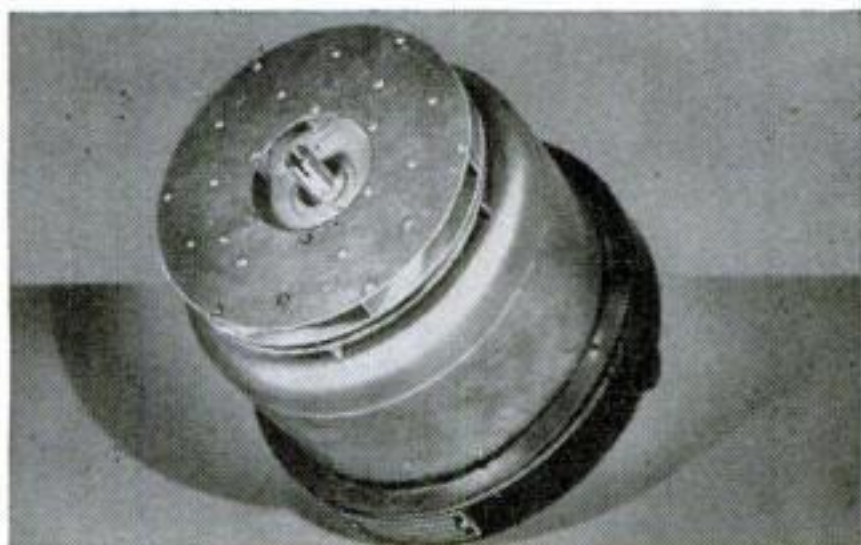
First step in modifying the cleaner is to remove the motor and fan unit. In the model shown, this involves taking off the two outside covers over the commutator end of the motor, and removing three screws in the bakelite rim. This frees the motor from the tank, and after a screw at the switch is removed, the whole unit can be withdrawn.

Take off the housing over the fans and unscrew the fan-retaining nut, which should be replaced with a threaded, slotted stud as shown in the drawing on page 214. This stud, made up from cold-rolled hex stock, should be turned, threaded, and slotted as

accurately as possible to minimize vibration. The thread on the motor shaft should also be matched as precisely as possible; the one on the motor shown appeared to be a special thread a few thousandths under  $\frac{1}{4}$ "-32, but a satisfactory job was done with a  $\frac{1}{4}$ "-32 tap by not passing it far enough into the stud to cut a full-depth thread. Cut a clearance hole in the fan housing and replace it.

For the new shaft, cut a length of  $\frac{5}{16}$ " drill rod to project about  $1\frac{1}{2}$ " beyond the end cap, a length of about 14" on the cleaner shown. Turn down and drive a pin in one end as specified in the drawing, and thread the other end  $\frac{5}{16}$ "-24 for possible use in driving an attachment. Before replacing the motor unit in the tank, check the fit of the shaft and the slotted stud; they should interlock lightly but with no backlash.

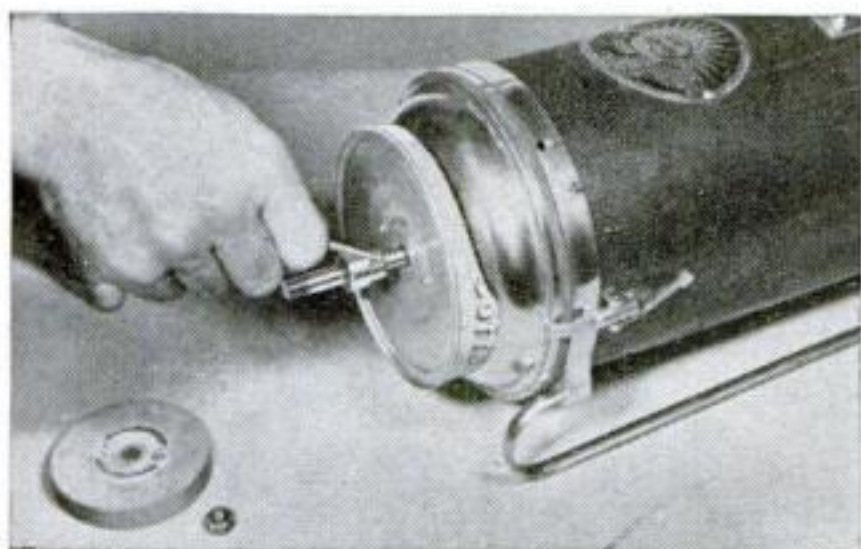
The outer bearing on the end cover is made of two pieces of brass bent as shown to fit snugly in the opening. They are placed



Replace the nut with this special slotted, threaded stud that both holds the fans and drives the shaft.



A hole must be punched in the perforated guard in order to permit the new shaft to fit in the stud.



With the tin-can dust shield in place, the threaded shoulder arbor is attached to the extension shaft.



A simple movable-core reactor affords one easy way to regulate the shaft speed for any particular job.



in the form of a cross and soldered securely together, and drilled at the center to take a bronze bushing, which is soldered in place and reamed  $5/16$ ". A brass or copper ring is soldered at the ends of the crossed pieces to fit them tightly against the cover and keep them from sliding through. Four brass clips, held on the inside with 6-32 screws, hold the assembly in place.

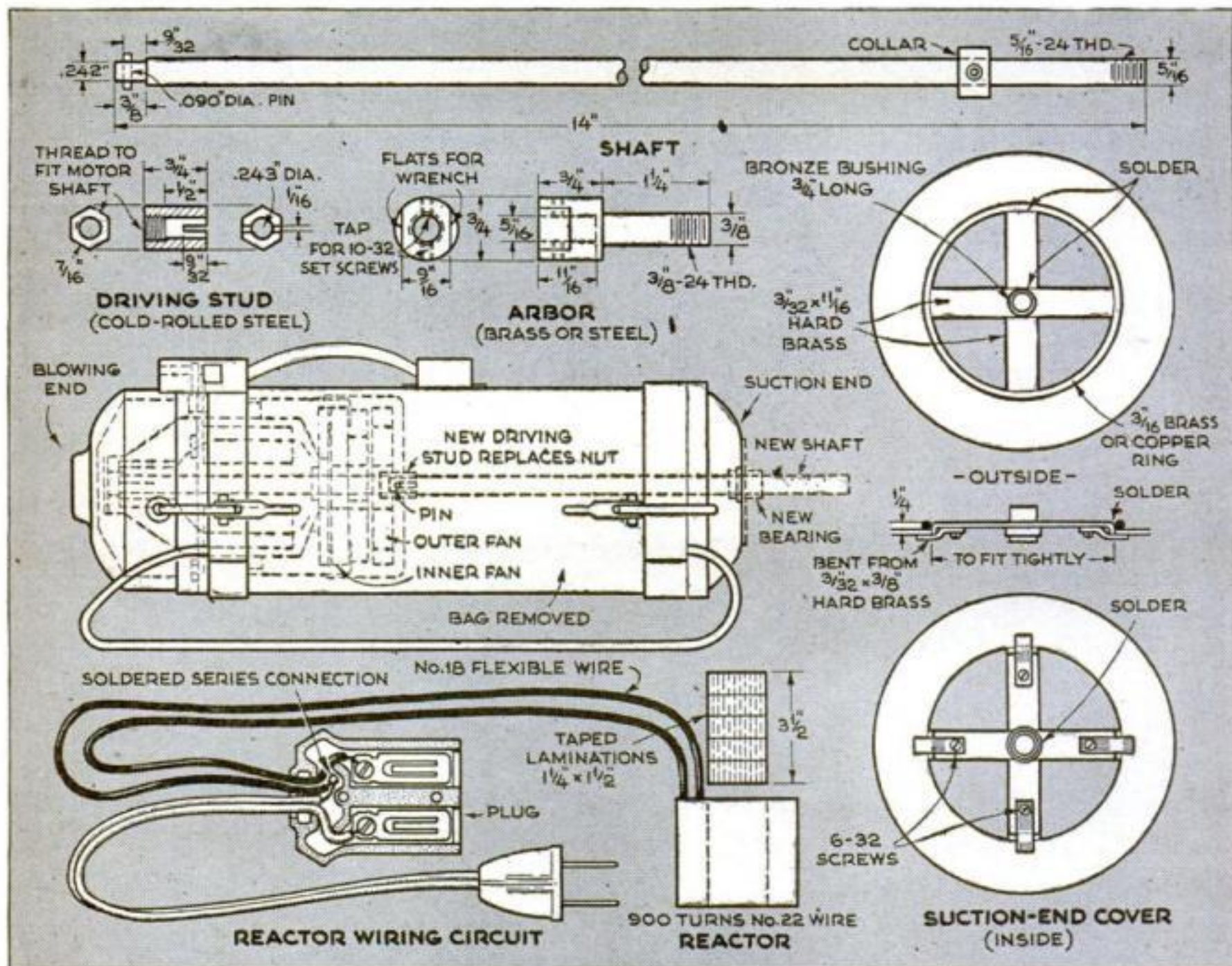
If the cover fits the tank loosely, as it probably will without the dirt-bag gasket to bear against, a special gasket can be cut from an old inner tube or a band of adhesive tape put over the edge of the cover. Oil the bearing and test the shaft for free turning. Tapping the cover may aid alignment.

An arbor, turned as specified in the drawing, will provide a shoulder against which grinding or buffing wheels can be held. Cut out the bottom of a tin can and screw it against the end to protect the motor from the grit of grinding and buffing. Leave a small slot to admit cooling air to the motor.

The cleaner shown is rated on its nameplate at 350 watts, and this and newer models are entirely suitable for conversion.

However, one early model, rated at about 150 watts, would probably not deliver much useful power. Vacuum-cleaner motors, almost always a series-wound or universal type, normally turn at high speeds. Running with no load other than the fans, the motor will turn at speeds up to 10,000 r. p. m., which is too high for most power applications. (Never run the motor *without* the fans or other limiting load.) The practical solution is to run the motor at less than full line voltage by putting either a resistor or (on A. C.) a reactor in series with it.

Shown below are details of a simple reactor that, with the iron core fully inserted, will cut the speed approximately in half. A rheostat capable of handling the motor current will also serve well, and is particularly suited where speed regulation is desired over a wide range, as for instance coil-winding at one extreme and buffing at the other. Less flexible in controlling speed but very simple is the expedient of wiring a lamp socket in series with the motor; lamps of 75-, 100-, or 150-watt rating can then be screwed into the socket to produce varying motor speeds.



Before making the stud, bearing, or shaft, check your own cleaner to see if these dimensions will apply.





# Back-Yard Boat Builders



**THREE-DAY BOAT.** Needing a tender to reach his 18' auxiliary moored off Staten Island, Frank R. Herbert, of Eltingville, N.Y., set to work on an 8' pram-type boat. In just three days, he had completed the job, attached a 2-hp. outboard, and put the boat in service. The tender has a 4' beam, with

frames, stem, and transom of oak. Waterproof gum plywood, screw-fastened and calked with glue, forms the sides and bottom. Corner pieces of mahogany were put in for stiffening, and a white cotton rope was added along the rail to serve as a bumper to protect the auxiliary.



**SIDE-WHEELER.** An old  $\frac{1}{2}$ -hp. gasoline engine taken from a discarded washing machine powers the 20" paddles on the sides of this odd-looking boat. The vessel, a 12-footer, was built by Raymond E. Goan, of South Portland, Me., for hauling in his lobster pots. Goan, a 25-year-old veteran of the Navy, finds it does its job well in spite of its antique appearance. He calls the craft the smallest side-wheeler in use.



# Steam-Bending as

**W**HEN a broken frame in a round-bottom boat must be replaced or reinforced, or a section of the planking has to be taken out and new pieces put in, one of the main differences between boat building and house building becomes immediately apparent. Houses are built in straight lines and angles. Boats are all curves. You'll even run up against double-twisters, known to the uninitiated as compound curves.

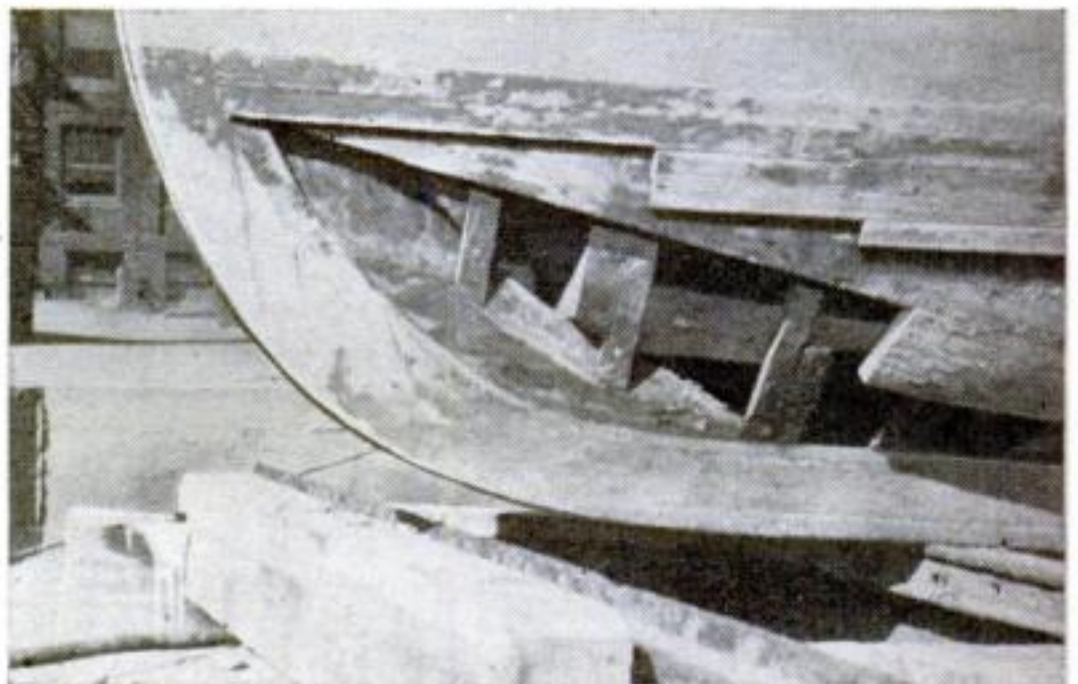
Often, in the case of planking, it is possible to bend the piece by hand and clamp

pressure. But this won't do if the planking is thick and short, especially if it is in the bow section. Then you need steam.

No special difficulty need be experienced once you understand the job to be done and have the equipment, which may be a simple steam box, such as a discarded boiler, and some means of boiling water in it or admitting steam. Professional builders seem to prefer softening wood to be curved by saturation in steam alone, but some go in for a combination steam and hot-water soak-



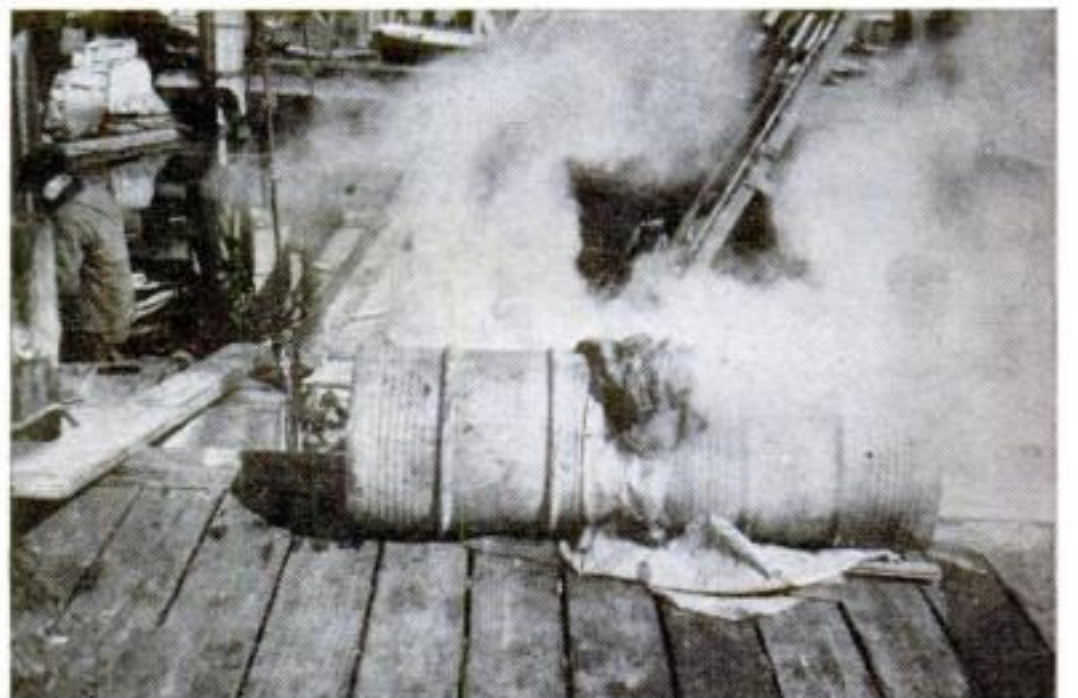
**1** Here's the job. Two heavy, short pieces of planking a full 1 1/4" thick had to be shaped to patch a stove-in hull section. It required steam-bending, not hard if you know how.



**2** Sheathing is removed from over the damaged planking in the bow, and the old planking is carefully sawed out to firm wood. Use care in the sawing, for the old pieces will serve as patterns for the new.



**5** Two empty 50-gal. oil drums serve as the steam box, one piece of new planking is put in them, and they are pulled together.



**6** Here steam is piped in by hose from a near-by boiler. The joint between drums is covered with an old tarpaulin. An hour's steaming may do.



# the Experts Do It

By **Elon Jessup**

ing. Hot water by itself will do in a pinch.

Bending may proceed in either of two ways after the wood has been softened. One is to nail it while pliable right on the boat—but this is a rush job, for the wood soon cools and stiffens. A more leisurely way is to bend with clamps, blocks, and wedges while the wood is hot, and then to fasten the piece in place when it has cooled. This is especially good with thick planking, but frames may fit better if bent directly into the average small boat.

The planking of the boat shown was a full 1½" thick, and the position in the bow of the repair called for considerable twist. In spite of this, the job was accomplished with a simple improvised rig. Steam from a near-by pile driver was conducted through rubber hose to a steam box consisting of two drums, each having one end open and covered at the joint with a tarpaulin.

Two other means of improvising steam boxes are shown in drawings. If more convenient, the drainpipe may be tilted and



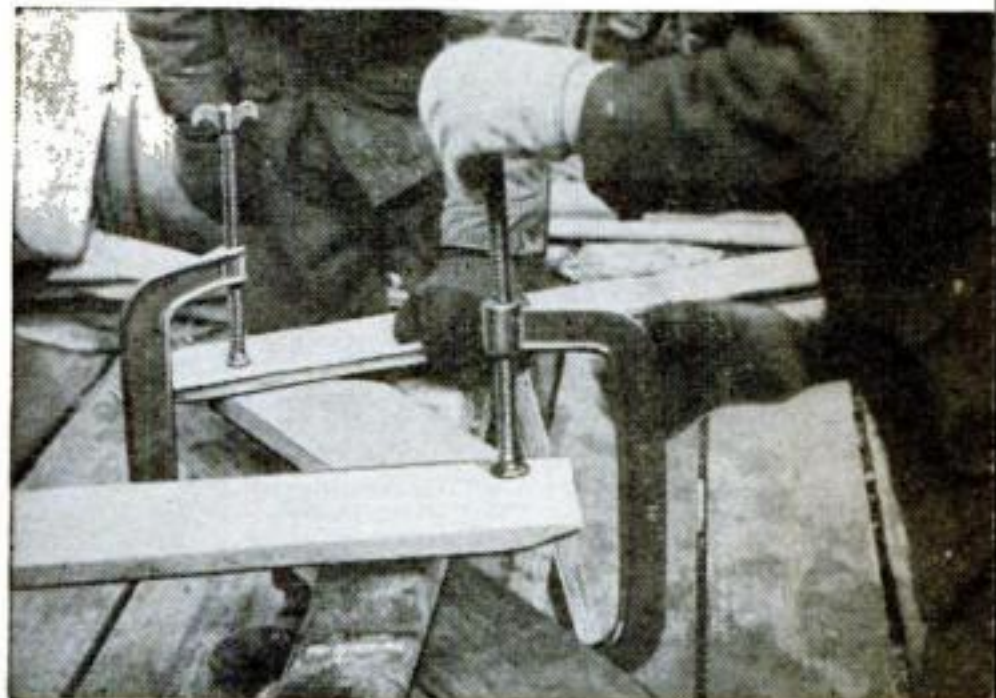
**3** Clamped to the new wood, an old section of removed planking forms a template for an accurate outline. Mark the shape of each piece to be replaced, and saw to the line so the patch will be a good fit.



**4** Another use is found for the old planking. It is laid out on a sawhorse, its center of twist studied, and is blocked up with wedges to give correct curve to the new piece.



**7** Fast work is needed in bending. The steamed wood is put on the blocks and wedges of the improvised press and clamped down quickly under crosspieces.



**8** C-clamps play an important part in bending. Have plenty in reach and, once they're set, don't release until the wood is cold.



the water heated in its lower end, or the galvanized tank may be set level and get its steam from outside. Even professional builders sometimes resort to the drainpipe when they have no regular steam box at hand. If a metal cap is brazed on the plugged end, that end of the drainpipe can be put directly into the fire, possibly into the home furnace. Either it or the tank can be played on with a primus stove or blowtorch.

Attach a heavy cord to the end of the wood pieces as they are put in the drainpipe or tank so they can be pulled out easily after steaming. Add more water when the level gets low. Round drainpipe can be used instead of rectangular for pieces in frames. Short, wide planks can be boiled in a washtub or ash can, or they can be sus-

pended on hooked wires above water level and steamed under sacks or an old blanket.

A large teakettle, refilled once or twice during the process, may be sufficient to introduce steam from an outside source. You may find a larger container useful if it has a tight lid and an opening in which the hose can be attached. When an outside source is employed, support the steam box at a higher level so steam will rise to it.

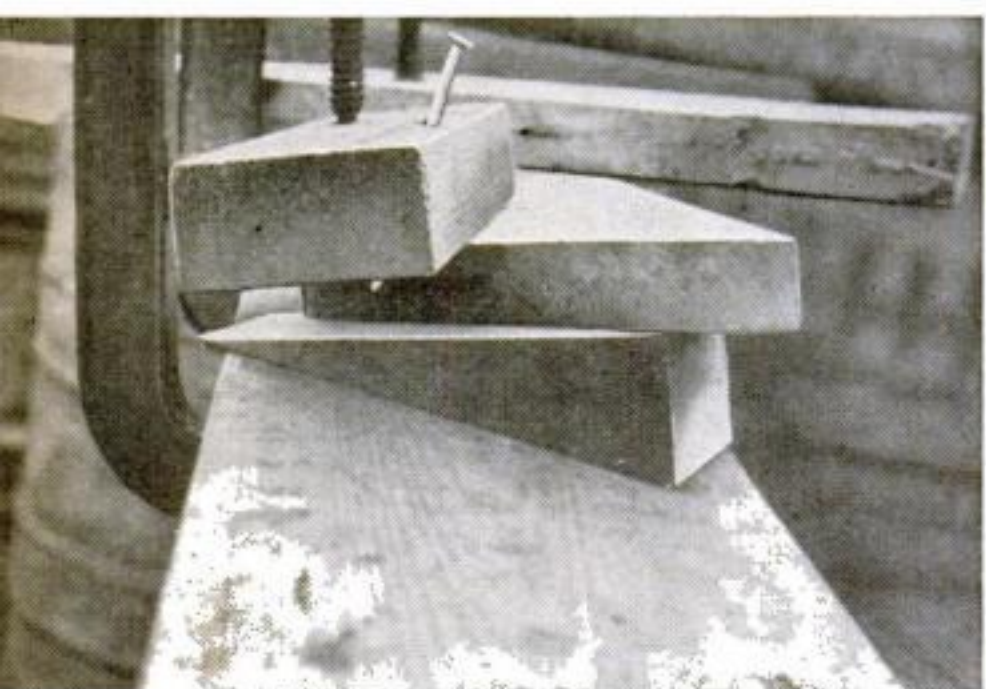
But there is more to steam-bending than the setup. Some amateurs are consistently successful, while others have their share of failures. It depends a good deal on the lumber and how long it is steamed. And for this, no definite time schedule can be offered. The time will vary with the kind of wood, its thickness, the amount of steam generated,



**9** More use is found for the old planking as clamping proceeds. Here it's held beside the new piece so the curves of the two can be compared and the proper twist obtained.



**10** It is better to give the new piece a little more twist than the old, for it will tend to straighten out some as it cools. A strut is shoved under here to help hold the wood in its permanent shape.



**12** Here is another view showing the action of clamps and wedge. Such an arrangement is useful when twist must be added to the curve.



**13** This is the second piece of new planking required for the patch. It is steamed separately and put under clamps. Not as much bend is needed.



the nature of the steam (wet steam is more efficient than dry), and the bend required.

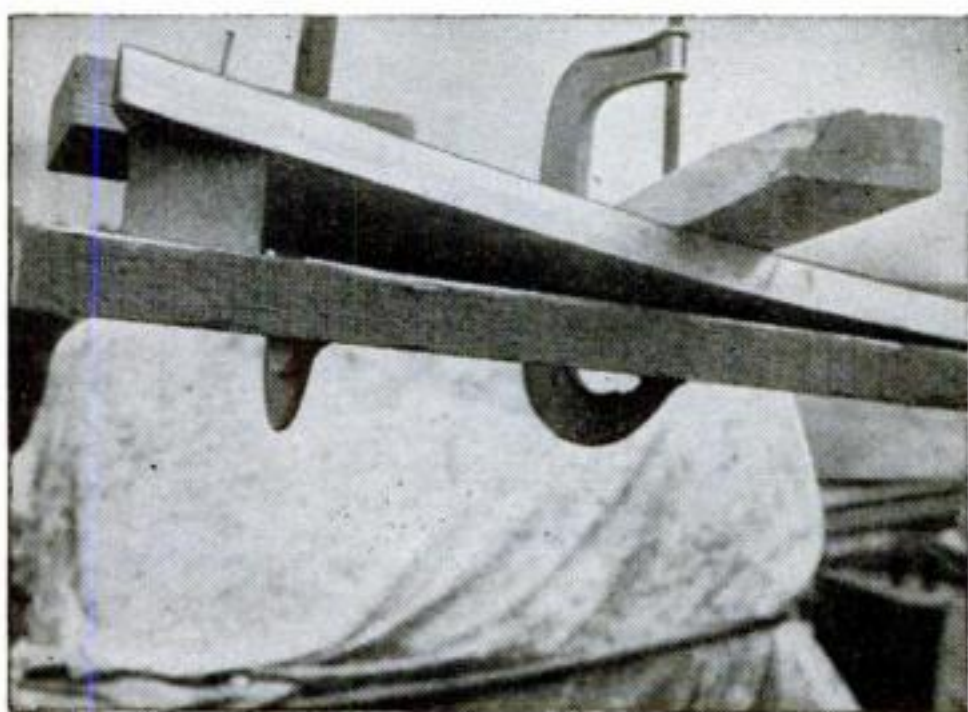
With experience, you will probably be able to hit the time just about right. If you feel that a piece hasn't been steamed long enough, don't hesitate to put it back into the steam bath. It is possible to steam wood too long, but most failures come from the opposite cause. In general, an hour of steady steaming can do no harm.

When steaming has been completed, lose no time in getting the piece bent to the curve you want. Give it a little more twist or bend than actually required since it will straighten some when cold and wood that hasn't been bent enough may always be a strain on the hull structure.

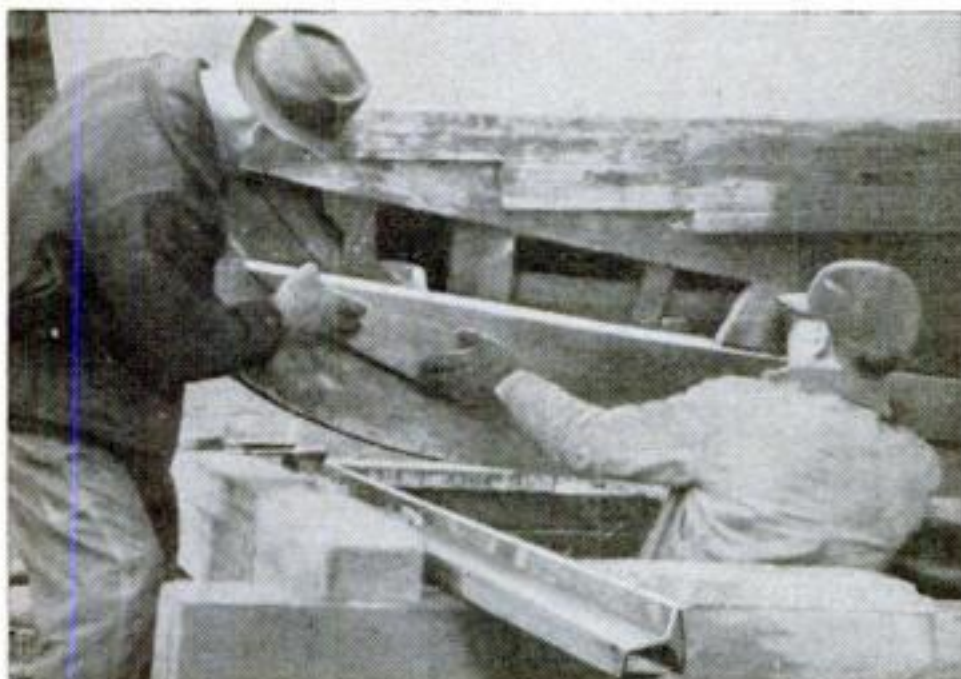
The wood should be cut to shape before

steaming. Use the old piece being replaced as a pattern if possible. Study the curves both before and during the clamping, and help get them right with blocks and wedges. The latter allow something of an adjustment, since they can be driven in further while the piece is still under clamps. Use plenty of clamps—C-clamps will do—and have extra ones near at hand. Once they have been tightened, don't release them until the wood is again cold and dry.

There's another very necessary addition to your equipment. You'll need the thickest pair of leather gloves you can find—hot wood can be awkward to handle. And call in a friend as a helper. Although it can be done by one man, steam-bending is really a two-man job. **END**

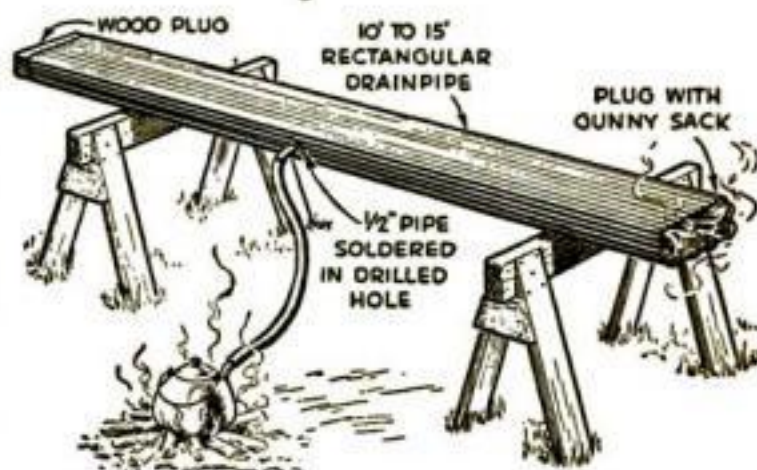


**11** Wedges like this will be found an invaluable aid in steam-bending. When more twist must be given the piece, they can be driven in further, often without even loosening the clamps.

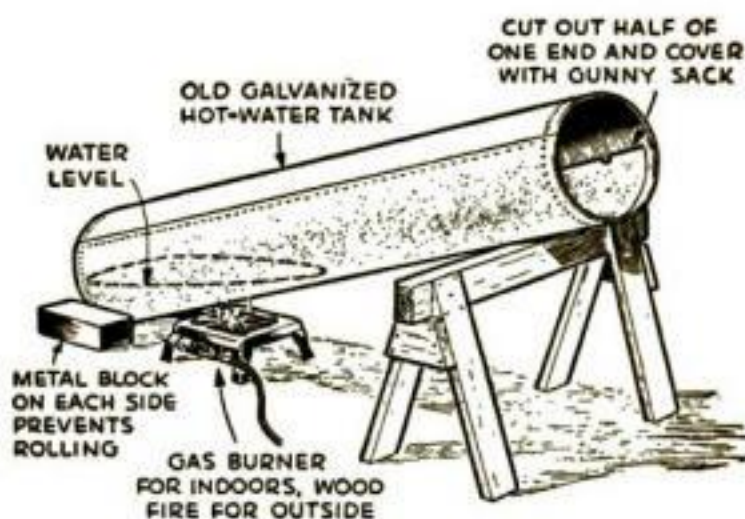


**14** Bending completed, the new pieces are fitted in place in the hull section, fastened down, and calked at the seams for tight joints.

## HOME RIGS FOR WOOD STEAMING



Rectangular drainpipe is often used by professional boat builders for steaming when regular rigs are not at hand. If a metal cap is used on one end, water can be held in it and that end placed in the fire.



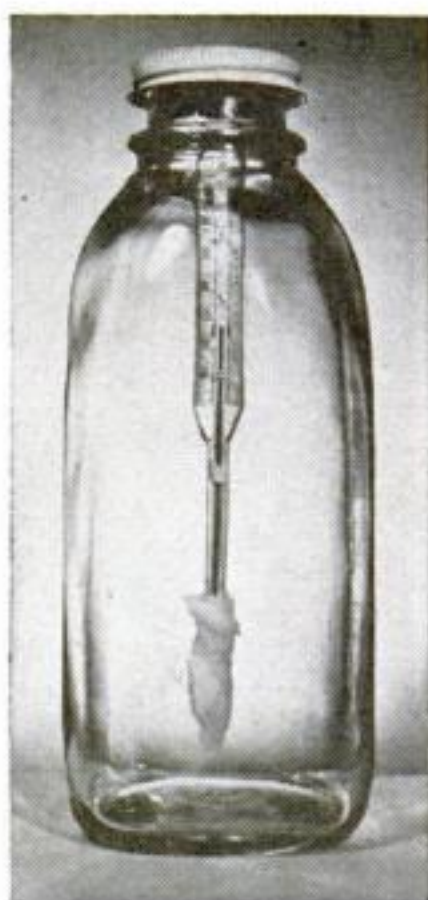
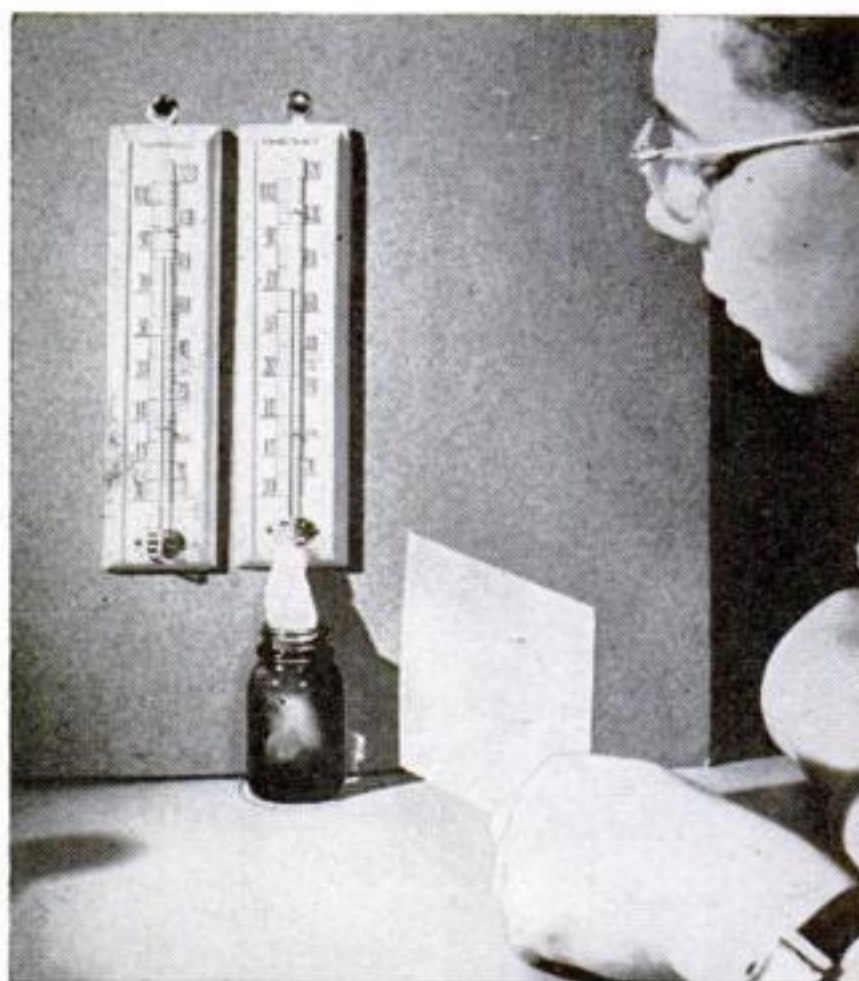
Another convenient steaming rig for wood is an old water tank with one end partly cut out. The boiler can be placed on two props, if preferred, and the steam led in by hose from an external source.



# Humidity Controls Comfort

**H**OW much water vapor there is in the air—or how little—is important to health and comfort. Everyone knows the sticky misery of hot, damp summer days and the equally annoying dryness of nose and throat in overheated rooms in winter. This *relative humidity*, the amount of water vapor contained in the air as compared with the amount that it can hold, is most agreeable at about 45 percent of saturation. The accompanying experiments will tell you more of its measurement and its effects.

## HOME EXPERIMENTS



**WHAT EVAPORATION DOES.** You feel cool on a hot day if the air is dry and perspiration can evaporate. Here's why. Wrap the bulb of a thermometer with wet cotton, suspend the thermometer in a jar, and cover the top. Slowly, as water evaporates, the mercury will drop, stopping when the air in the bottle becomes saturated. Then, when no more water can evaporate, the temperature will rise again to that of the room.

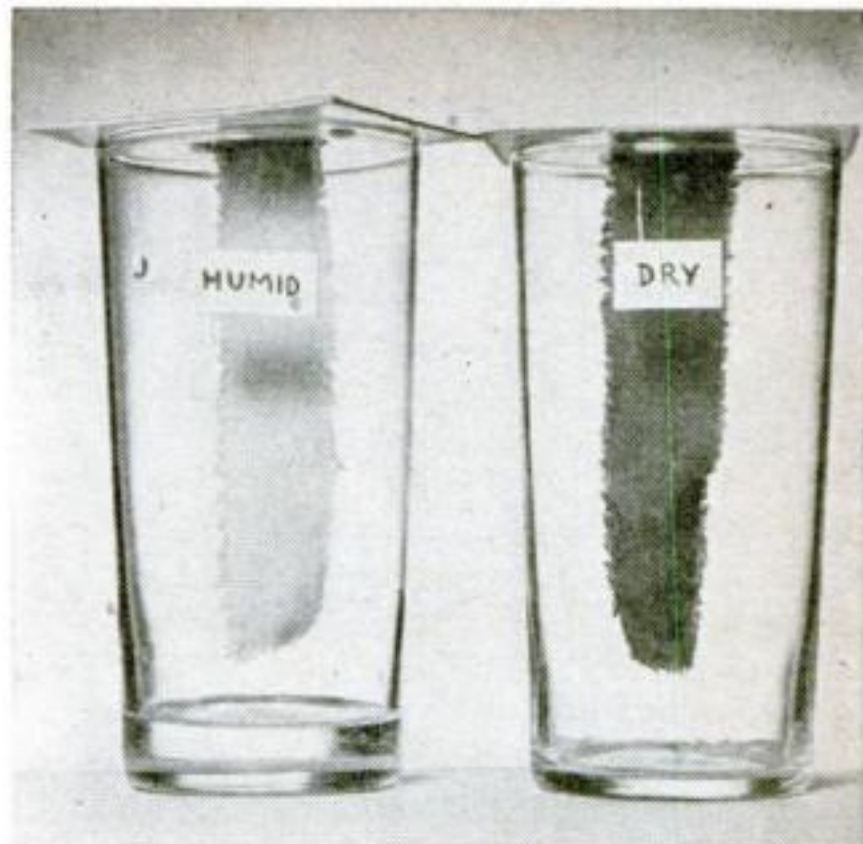
**DETERMINING RELATIVE HUMIDITY.** The rate of evaporation of water, and hence its cooling effect, will depend upon how saturated with moisture the surrounding air is. Thus relative humidity can be measured by comparing the readings of dry- and wet-bulb thermometers. Mount two ordinary thermometers next to each other. Leave the bulb of one dry, but wrap that of the other tightly with absorbent cloth having a loose end dipping into a small bottle of water. When the cloth has become thoroughly wet, fan the air about the thermometers rapidly for a few minutes and note the two readings. The relative humidity can be found by referring to the table below.

Dry-bulb temp. (deg. F.)	Difference between dry and wet bulbs (deg. F.)					
	3	6	9	12	15	18
65	85	70	56	44	31	20
70	86	72	60	48	36	26
75	87	74	62	51	40	31
80	87	75	64	54	44	35
Relative humidity (percent)						





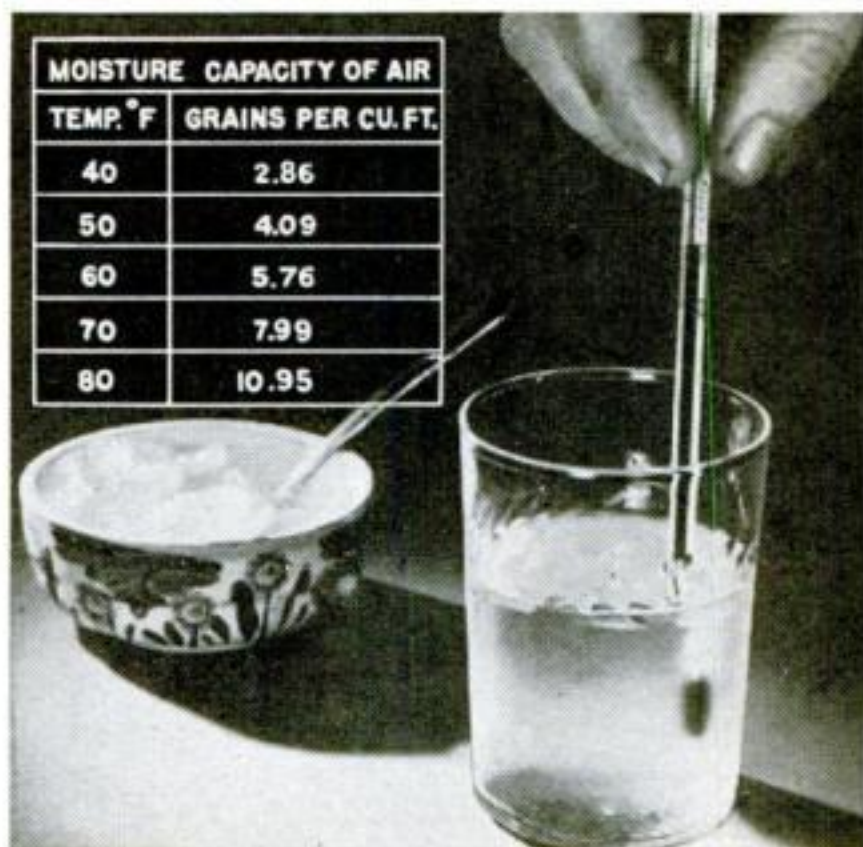
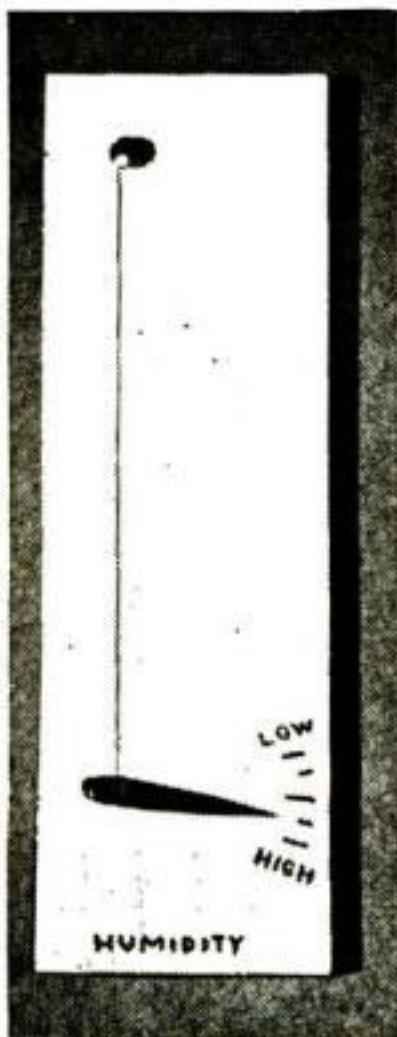
**COLOR HUMIDITY INDICATOR.** Remember the old-fashioned cloth flowers and doll dresses that changed from pink to blue and back again? Humidity did it. They had been soaked in cobalt chloride, the crystals of which lose water and turn blue in dry air and absorb water and turn pink in moist



air. To demonstrate, prepare cloth strips by soaking in a moderately strong solution and let them dry. Hang one in a tumbler containing a little water and the other in one that has been warmed dry. The former will become bright pink and the other deep blue. Switch them, and their colors reverse.

**DAMPNESS AFFECTS HAIR.** Relative humidity can be measured by a hair used as the operating element of a simple hygrometer, because hair stretches in humid weather and shrinks when the air is dry. Select a hair at least 6" long and wash it carefully in alcohol or ether to remove all grease. Then

with a spot of sealing wax attach one end near the top of a sheet of cardboard and the other to a pointer near the lower end. The pointer, which may be cut from tin-can stock or other light metal, is pivoted on a small nail to magnify the change in length of the hair. For fairly accurate readings, the improvised instrument can be calibrated by comparison with the wet- and dry-bulb thermometer table given on the facing page.

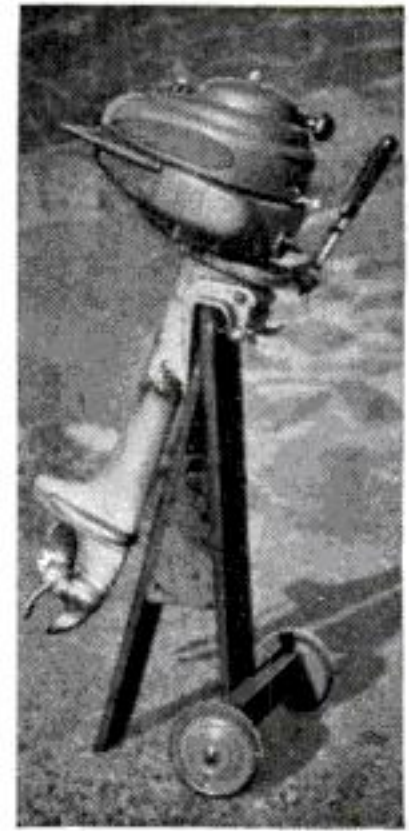


**WHAT THE DEW POINT SHOWS.** Condensation helps in calculating relative humidity. Half fill a tumbler with water and stir with a thermometer while adding ice. Note the temperature at which the glass begins to "sweat"; then add no more ice and take a reading when the moisture disappears. The average of the two is the dew point. Moisture capacity (from the table above) at room temperature divided by that at the dew point gives relative humidity.

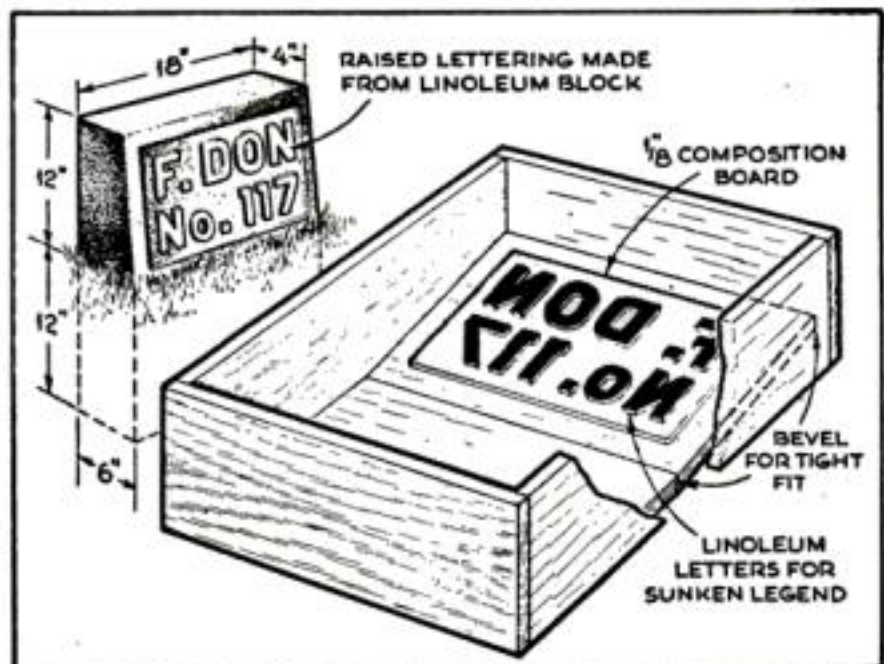


## Scooter Rolls Outboard Motor

SCRAP boards, a couple of 5" wheels, and some screws and washers were used in the construction of the motor carrier shown in the picture at the right. Two flat pieces—screwed together at the top and braced about midway by a small triangular piece form a sturdy stand. Fasten an axle and toy-wagon wheels to the foot of one of the boards. It will stand by itself when left upright. The motor



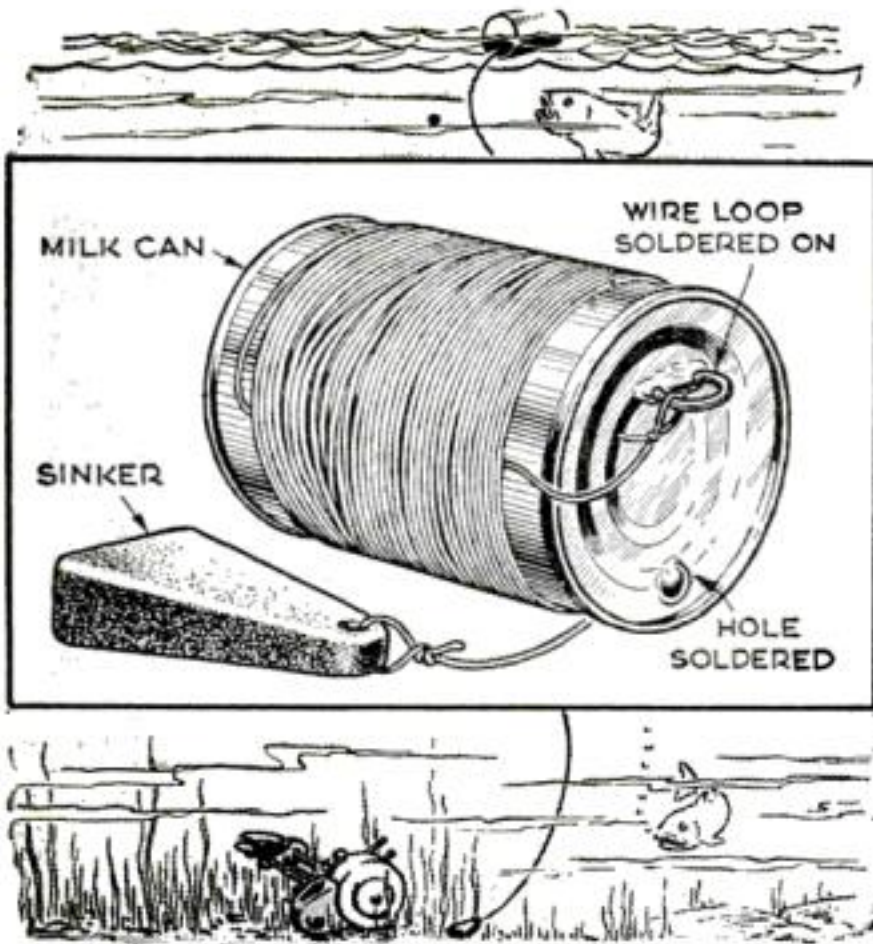
is clamped to the top of the carrier, and the rig is steered and pushed by means of the motor handle.—C. DE WITT ROGERS, JR.



## Lawn Block Is Cast in Concrete

STONECUTTING is a job few householders want to tackle, yet many would like permanent lawn markers bearing their name or house number. The marker shown is cast concrete. Inscriptions may be either raised or sunken. A linoleum cutout is used for molding the former, and linoleum letters are nailed to a composition-board backing for producing the latter. A decorative design may be added.

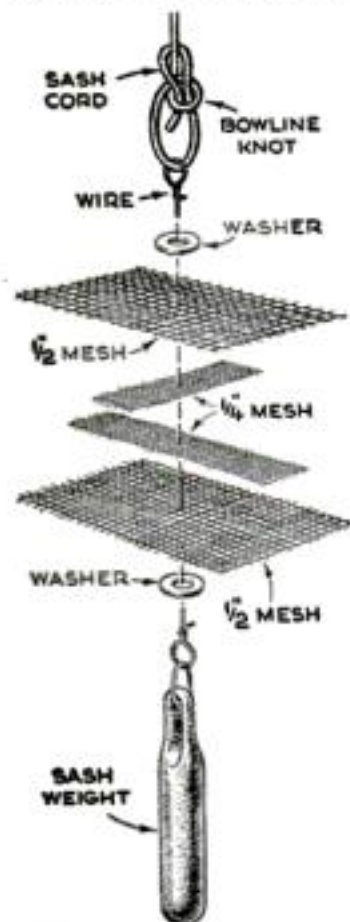
Make a wooden box for the form. Set in half the bottom at an angle, beveling the edges for close, leakproof joints. Line the section above ground with cardboard to keep grain from "printing."—C. L. MEEHAN.



## Buoy Tags Gear Lost Overboard

FISHING and boating gear is occasionally lost overboard, and when you're out too far to take bearings from the shore, it is almost impossible to relocate the spot. This marker, made of an empty milk can, a sinker, and a length of line great enough to reach bottom at any likely depth, provides a quick, sure way to locate the place where the loss occurred. With the hole or holes soldered closed, the can will float at the end of the anchored string until you can return to grapple for the lost article.—W. BALLINGALL.

## Wire Screen Sweeps Chimney



WHEN chimney-cleaning time rolls around, a sweep like the one shown here will scrape away soot in a hurry. Being flexible, it will adjust to minor obstructions and offsets. Two pieces of coarse screen are laid together with two strips of finer mesh crossed at right angles between them. Thread a piece of wire through to hold the sandwich tight, tie a length of sash cord to the top, and add a weight to the bottom to pull the sweep down.—J. F. ALSTAD.

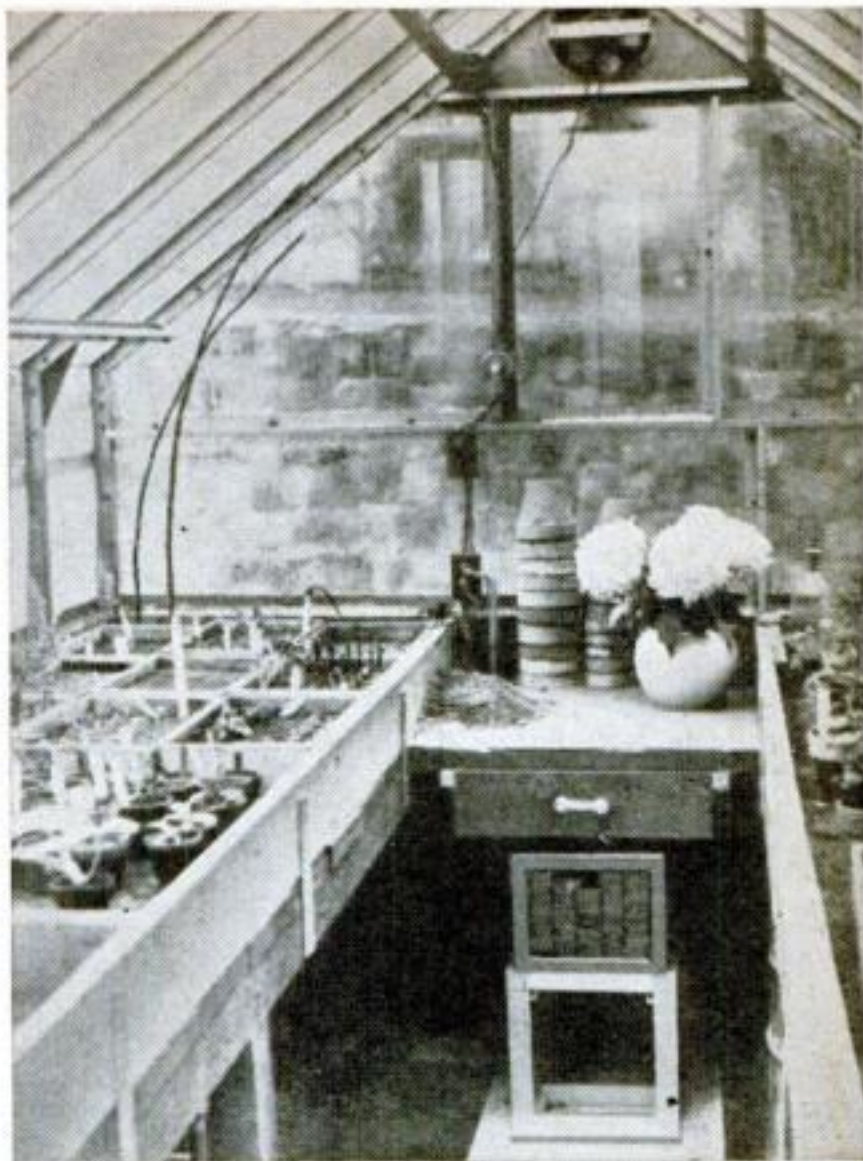




## Greenhouse Framework Is Built of Surplus B-29 Wing Spars

ALUMINUM wing spars, war surplus from Superfortresses, serve as the framework for this greenhouse built on a cement-block foundation. The glass is fixed to the aluminum frame with spaced clips embedded in gun-calking compound, also a war surplus.

A 1½-kw. heater (under the bench), electric cables heating the propagation beds, and two ventilating fans are controlled by thermostats.—FRANK P. CLEMENTS.

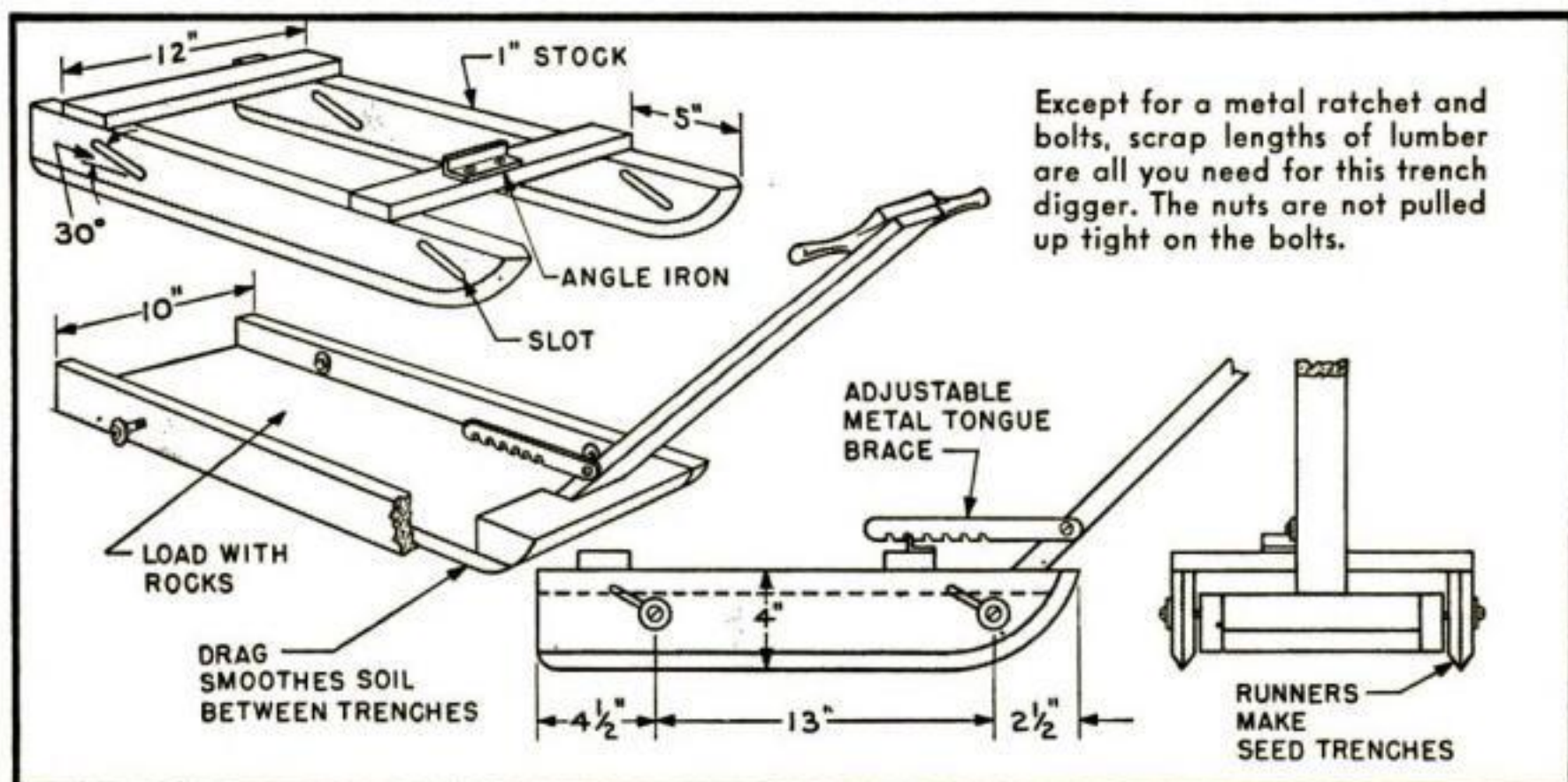


## Beveled Runners on Drag Cut Parallel Trenches for Seeding

MAKING parallel trenches of uniform depth for seed, difficult at best with a hoe or pointed stick, is a quick job with this trenching drag. Constructed with runners like a sled, it is adjustable to different depths and, weighted with rocks, smooths the soil between the rows.

Bevel the runners to a sharp edge on the bottom—they cut the trenches—and mount

them on the inner drag with four bolts put through the 30-deg. slots. Moving the runners all the way forward makes the deepest trenches, all the way back the shallowest. A ratchet on the handle bar will hold them in the desired position. If rows spaced wider than 12" are required, simply move the drag over, lapping one set of trenches, and use only the outer ones for seeding.







**GASOLINE BURNER KILLS WEEDS.** This ground clearer has an adjustable burner head to sear out grass and weeds along a fence and in other spots inaccessible to a sickle or mower. The flame nozzles, mount-

ed on a steel-tubing boom, can be raised, lowered, or twisted to a 45-deg. angle. A three-hour supply of gasoline or kerosene is held in the tank. The Killall burner is made by General Corporation, of Dallas, Texas.

## FOR EASIER FARMING



**ROTARY-PLOW CULTIVATOR.** Plowing, disking, and harrowing are done in one operation by the 1947 model Tillex "31," made by the Bray Corporation, of Pasadena, Calif. The frame and motor and plow housings are of all-aluminum construction, reducing total weight to 325 lb. This lightness makes the cultivator suitable for gardens, but the machine is strong and durable enough for use on large farms as well.



**TUMBLER TREATS SEEDS.** A discarded can forms the tumbling chamber of a homemade seed treater built by Meade Pottenger, of Hamilton County, Ohio. Mounted on an axle with an auto wheel and tire for easy hand operation, the device mixes seeds and hormone, antirot, or other treating dusts thoroughly even in big quantities.



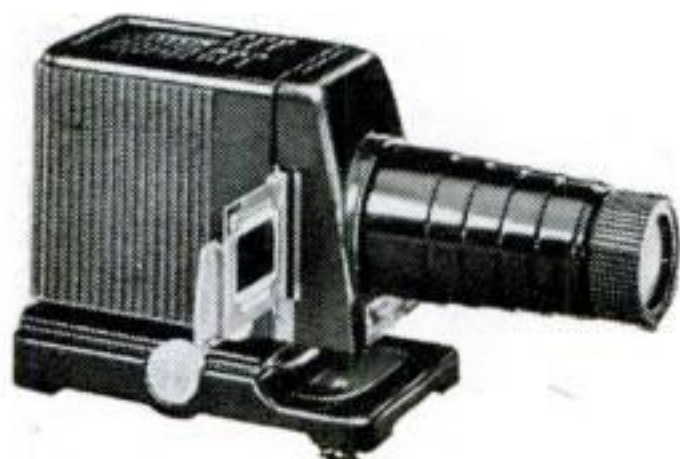
# FOR SUPERB COLOR SHOWS...

## Kodak Still Projection Equipment

Set up your trim, efficient Kodaslide Projector; load as many as 46 slides in the Kodaslide Changer . . . and you're off to a brilliant showing.

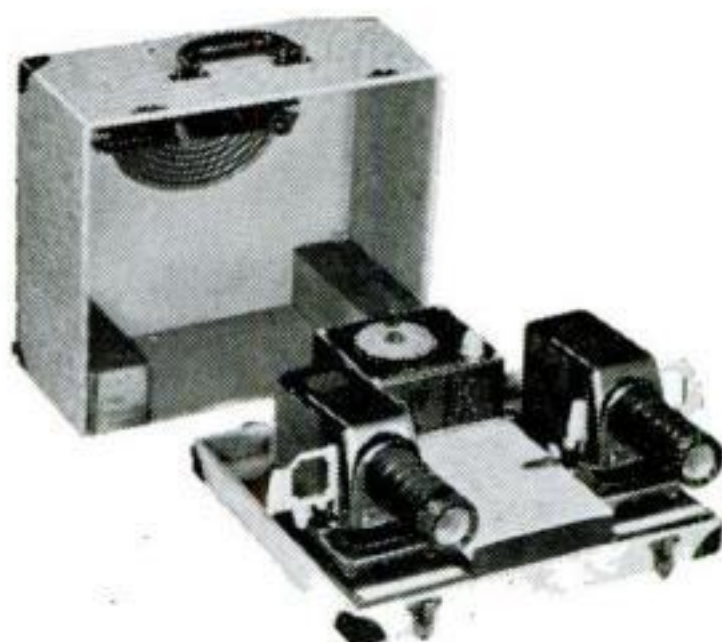
For the slick professional touch, use two Kodaslide Projectors, with the Kodak Dissolve Control Outfit . . . one slide fades out as the next fades in. Consult your Kodak dealer about this equipment . . .

EASTMAN KODAK COMPANY, ROCHESTER 4, N. Y.



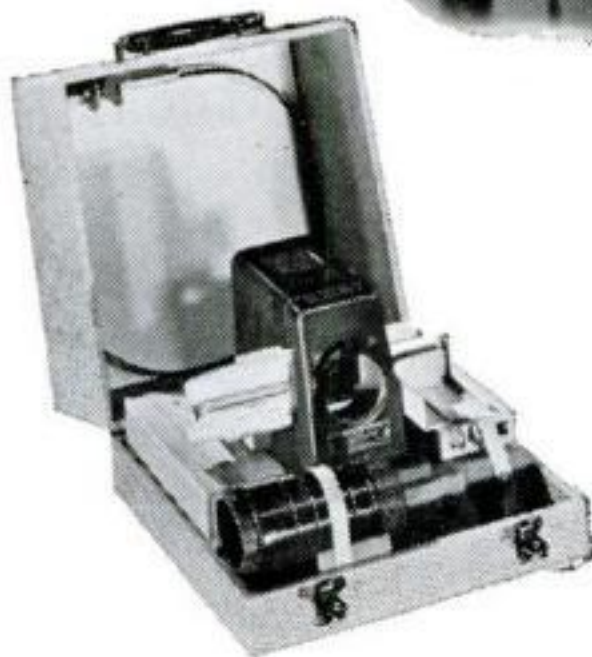
**Kodaslide Projector, Model 2A,  
with 5-inch f/3.5 lens**

Shows your Kodachrome transparencies brilliantly. Lenses and entire optical system *Lumenized*—ultrahard coated. Result: approximately 50% more illumination delivered to your screen . . . Accessory 7½-inch f/4 lens also available.



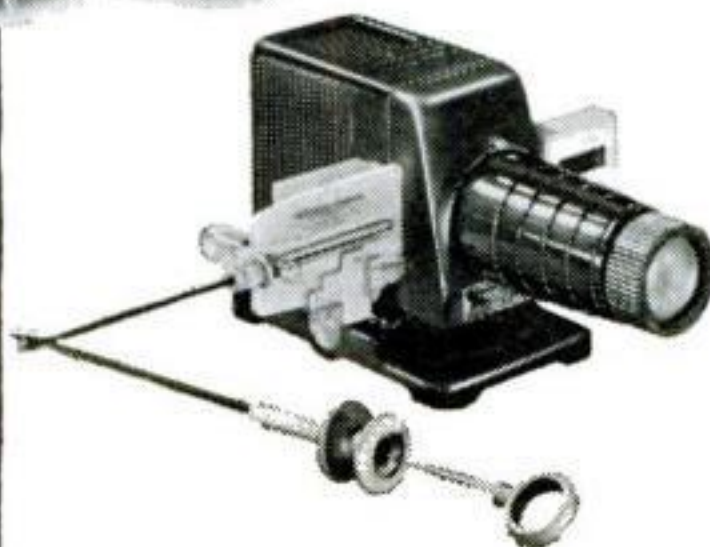
**Kodaslide Dissolve Control Outfit**

One image appears on screen as other fades out. No awkward pauses, no "break." Outfit consists of case, electrical control unit, two projector platforms, storage space for lens barrels and slide files. (Projectors not supplied with unit.)



**Combination Case**

Provides space for Kodaslide Projector, Model 2A, spare lamps, the lens, a Kodaslide Changer, and two Kodaslide Sequence Files. Removable cover contains matte screen for trial projections.



**Kodaslide Changer (shown  
here on Model 2A Projector)**

Hand-operated plunger (30" cable) automatically changes up to 46 Kodaslides. Fits Kodaslide Projectors, Models 1, 2, 2A.

# Kodak





*the right files for  
the Home Workshop*

**M**ODEL MAKING . . . woodworking . . . metal work . . . whatever your hobby, it's bound to give you more satisfaction when the tools you use are tops in quality and *right for the job*. In files, that means Nicholson or Black Diamond.

Use small size, single cut standard files and X.F. Swiss Pattern Files on delicate metal parts. Rasps and double cuts for woodworking. Milled Tooth and Super Shear Files for soft metals and plastics. Mill Files for sharpening and smooth finishing.

Shapes and sizes for most any job are obtainable through the better hardware stores and industrial supply houses.

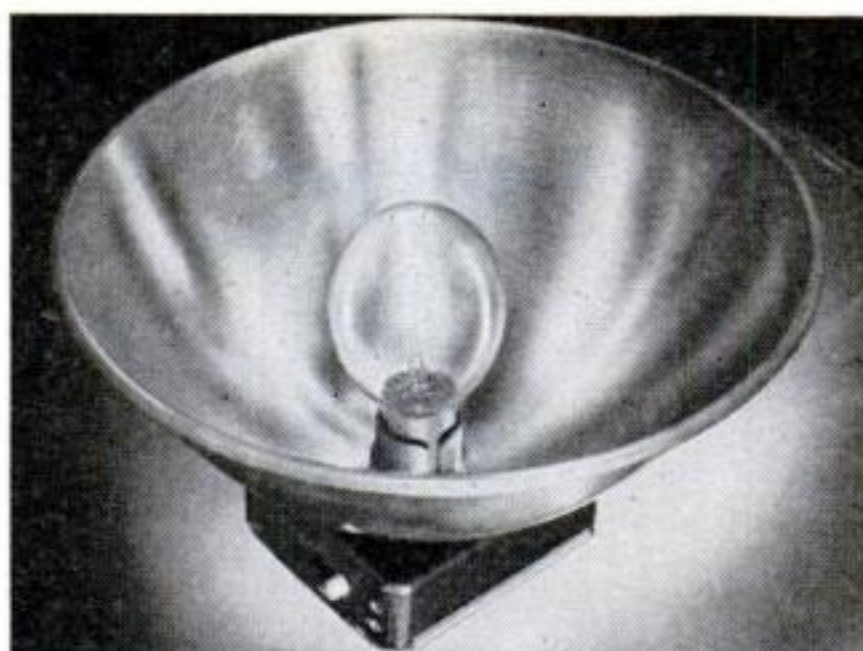
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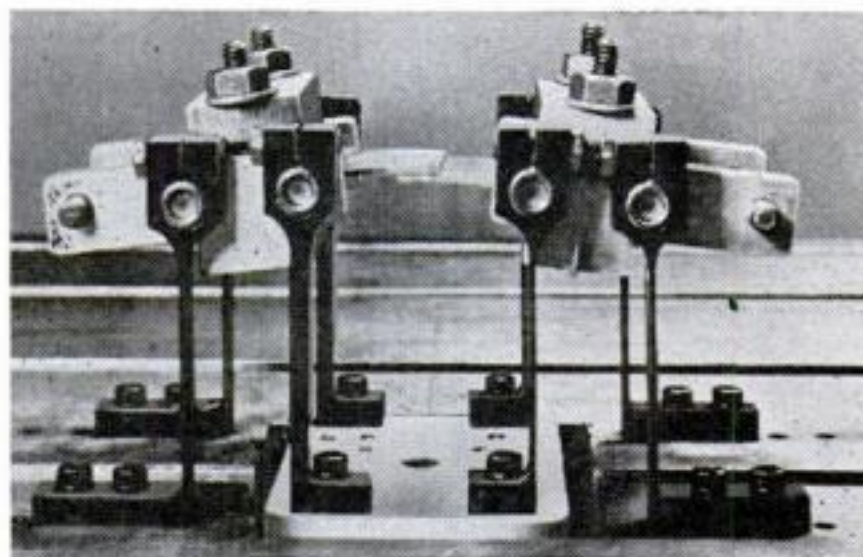


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**FILES** FOR EVERY PURPOSE



## Hand Flash Unit Fits Palm

COMPACT and convenient, the Hand Flash Synchronizer, manufactured by the Peak Photo Products Company, features a battery case that fits into the palm of the hand and a centrally located push-button release for ease of operation.



## Strong Plastic Glues Metal

A NEW plastic adhesive, used in cementing pieces of metal together, was found in recent fatigue tests to be stronger than the metal on which it was tried. In the machine shown above, alternating bending stresses, repeated millions of times, were applied to specimens of 1/16-inch duraluminum cemented together with the plastic. In all but one of 15 tests, conducted by the Sonntag Scientific Corp., the adhesive held while the metal fractured. Small photo shows a specimen of the duraluminum before (top) and after (bottom) undergoing the test.







*Radiator rusted-  
Vacation busted*

*Clean out rust with*

### **DU PONT Cooling System CLEANSER**

Before your engine is ruined by overheating, clean out rust and scum in the radiator. Just pour in a can of DU PONT COOLING SYSTEM CLEANSER, run the engine 30 minutes or more, then drain. No reverse flushing is necessary. It dissolves rust—cleans thoroughly, quickly, and safely.



*Then keep out rust with*

### **DU PONT Acid and Rust INHIBITOR**

After cleaning out the radiator, you can keep it free from rust all season by pouring in a can of DU PONT ACID AND RUST INHIBITOR. This neutralizes the acid and prevents damaging rust from forming.



*Avoid radiator leaks with*

### **DU PONT Cooling System SEALER**

You can stop leaks quickly and securely—and make the cooling system LEAK-PROOF—by pouring in DU PONT COOLING SYSTEM SEALER. It will not clog the radiator or harm hose or metal parts.



**DU PONT**

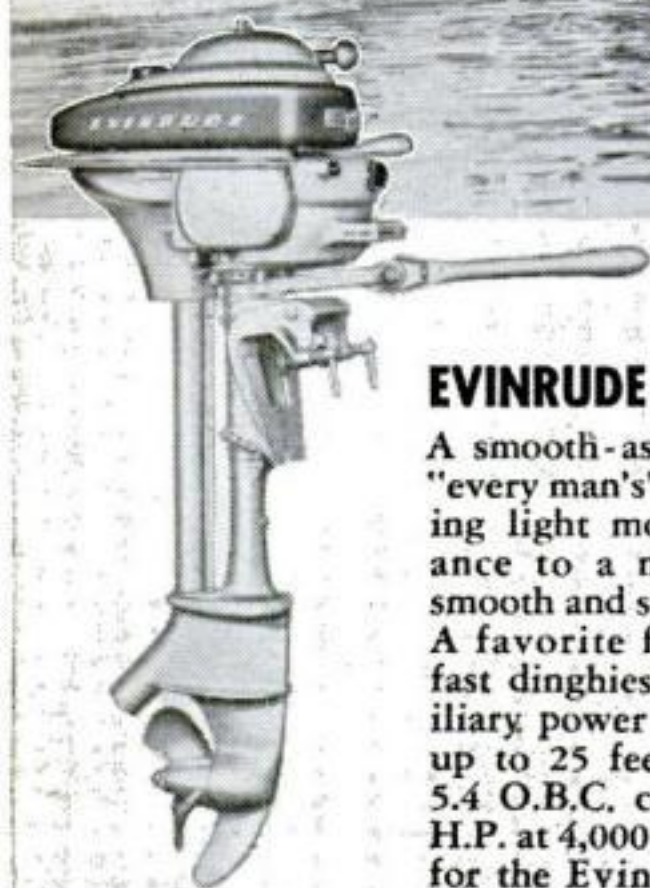
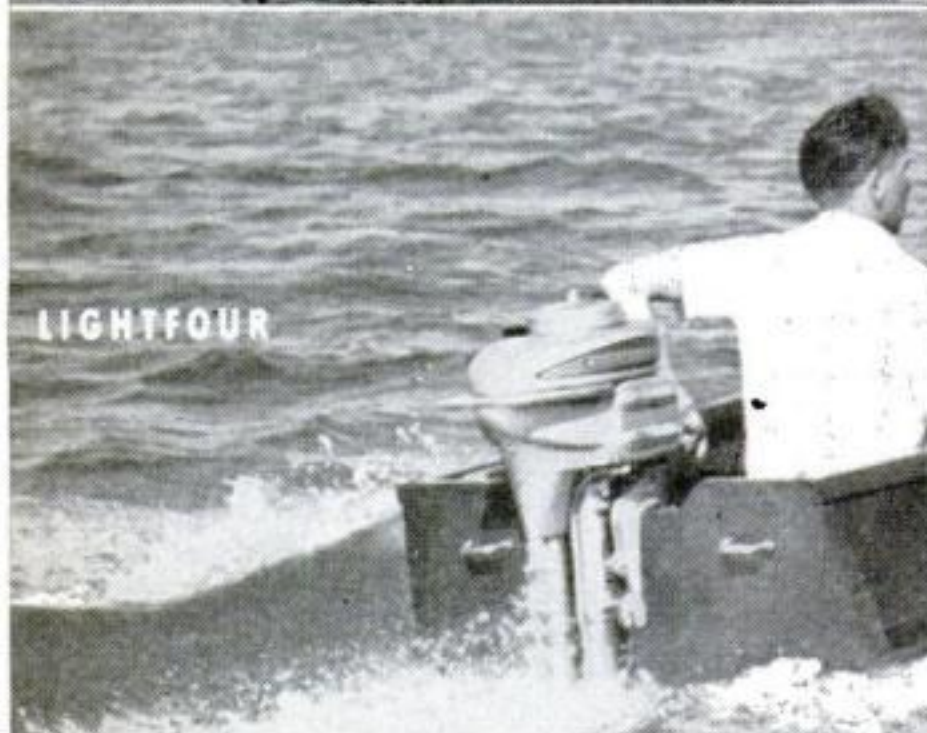
REG. U.S. PAT. OFF.

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...THROUGH CHEMISTRY

JUNE 1947 227



# There's a "Four" for YOU—



## EVINRUDE "ZEPHYR"

A smooth-as-silk four in "every man's" size—bringing light motor performance to a new level of smooth and spirited action. A favorite for powering fast dinghies and for auxiliary power on sail boats up to 25 feet. Develops 5.4 O.B.C. certified brake H.P. at 4,000 R.P.M. Write for the Evinrude catalog.

**—just right in size, power, performance . . . in Evinrude's complete line of 3 thrilling four-cylinder models!**

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## ***New wings for words around the world!***

**Radiograms "Via RCA"** to and from overseas points now are processed by automatic machines which speed your messages through such gateway cities as New York, London, San Francisco and Manila, without delay.

This advanced technique in international radiotelegraphy is the result of wartime research and development. It gives to private messages the same speed, accuracy and dependability which were attained through its use by the U. S. Army Communications Service during the war.

RCA Laboratories—one of the

world's foremost centers of radio and electronic research—is continually pioneering and advancing radio communications in service to the Nation and the public.

When you buy an RCA Victor radio or television receiver, Victrola radio-phonograph, or phonograph record, you are getting, thanks to RCA research and engineering, one of the finest products of its kind science has achieved.

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Radio Corporation of America, RCA Building,  
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the RCA Victor Show, Sundays, 2:00 P. M.,  
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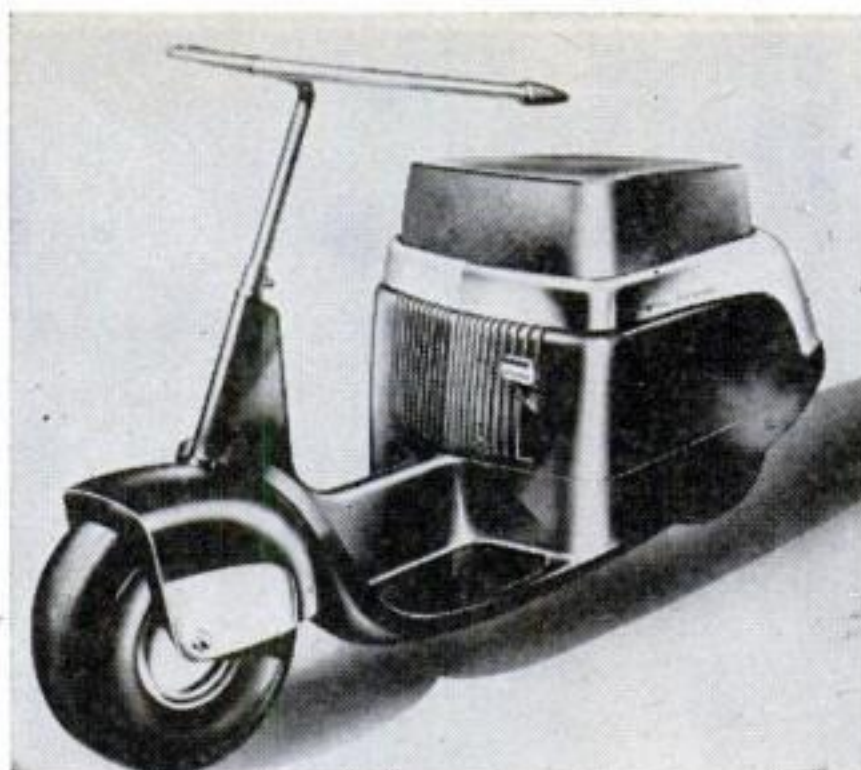
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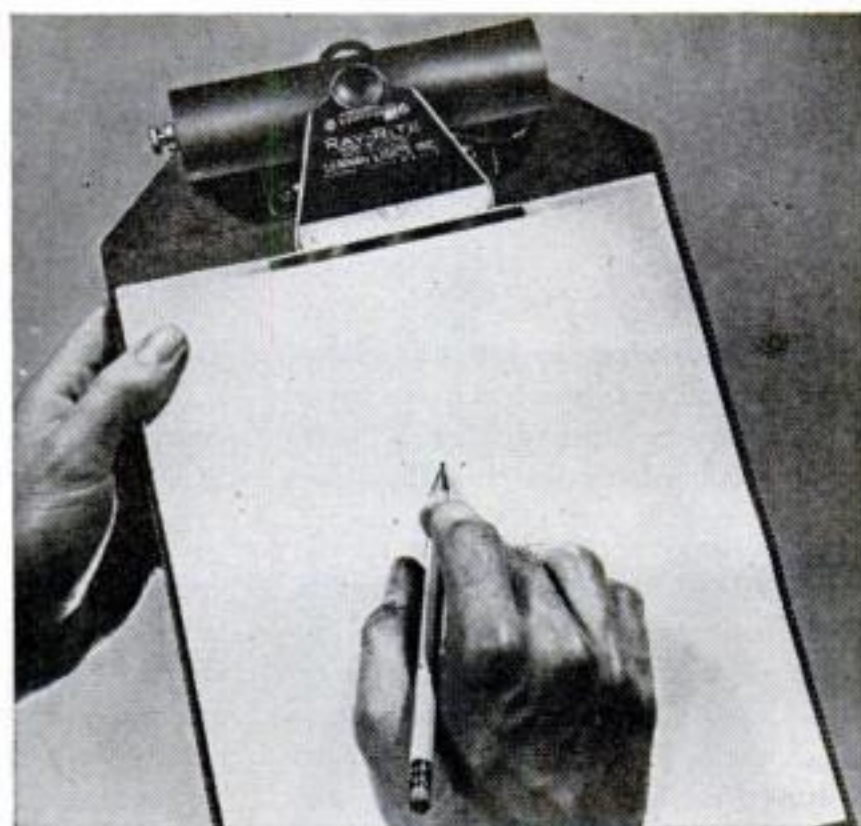
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## Magnesium Scooter Is Compact

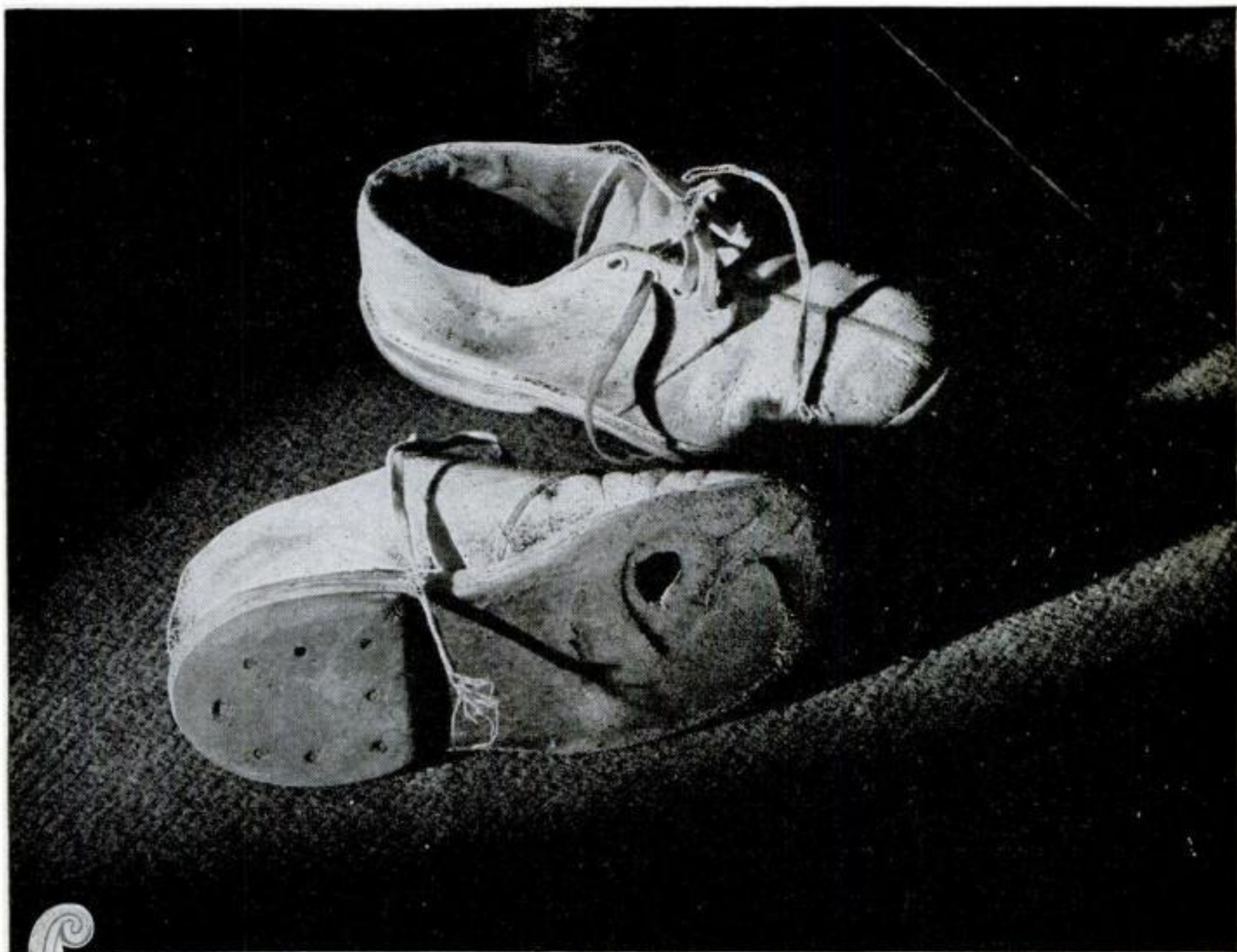
SMALL enough to fit into the average-size automobile trunk yet durable enough to carry full-size adults, this chunky scooter weighs only 75 pounds. Made by McCulloch Motors Corp., of Los Angeles, it is constructed almost entirely of an aircraft-type magnesium alloy, and is powered by a four-horsepower engine. The scooter is equipped with easy-riding balloon tires and a foam-rubber seat.



## Clip-board Sheds Own Light

WRITING in poorly lighted areas becomes an easy task with the illuminated clip board manufactured by Lennan Lights, Inc., of Burbank, Calif. Two standard flashlight batteries operate a light bulb set in a reflector that is built into a sturdy metal spring clip. The board is available in two sizes: 7 by 12 inches and 9 by 14 inches.





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**P**iston rings are *replacement* parts . . . they're made to "take" the wear . . . to protect your engine . . . to be replaced again and again. And the sooner you replace worn-out rings, the longer your engine will last . . . the better and more economical it will run.

When smoke, excessive oil-consumption and half-hearted engine performance first warn that you need new piston rings, play safe—install Hastings rings, at once.

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Remember that name—Hastings Piston Rings—the best money you can spend on your car.

HASTINGS MANUFACTURING COMPANY, HASTINGS, MICH.  
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**TOUGH** on Oil-pumping  
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"Dear Fred:

"Enclosed is a picture of a nice mess that were caught on a frog Jitterbug, and a black Jitterbug. They were taken from Orange Lake, near Newburgh, N. Y., at night. The four largest weighed 6 lbs. apiece, and they totaled 46 lbs. We get good results from all patterns of Jitterbugs, especially at night."—Capt. P. C. Harold, S/Sgt. F. M. Stockwell, Newburgh, N. Y.



*Frog Jitterbug  
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3/8 or 5/8 oz. same price.*

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Fishermen get a kick out of using the Jitterbug. Its gurgling, paddling action is as fascinating to them as it is to fish. Bass strike it viciously. And the thrill-packed action is right on the surface where you can see and hear it.

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Beautifully illustrated in colors. Contains many photographs and letters from fishermen telling where and how record catches were made with Jitterbugs, my famous surface bait, Hawaiian Wigglers and Hula Dancers. Also available, 16 mm. colored movies for showing to sportsmen's clubs.

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*Capt. Harold and Sgt. Stockwell with their  
string of bass caught on Frog Jitterbug*





# SPEAKING OF RECORDS by FRANK WILLIAMS

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WORLD'S BACKSTROKE RECORD FOR MEN—

ADOLPH (SONNY) **KIEFER**

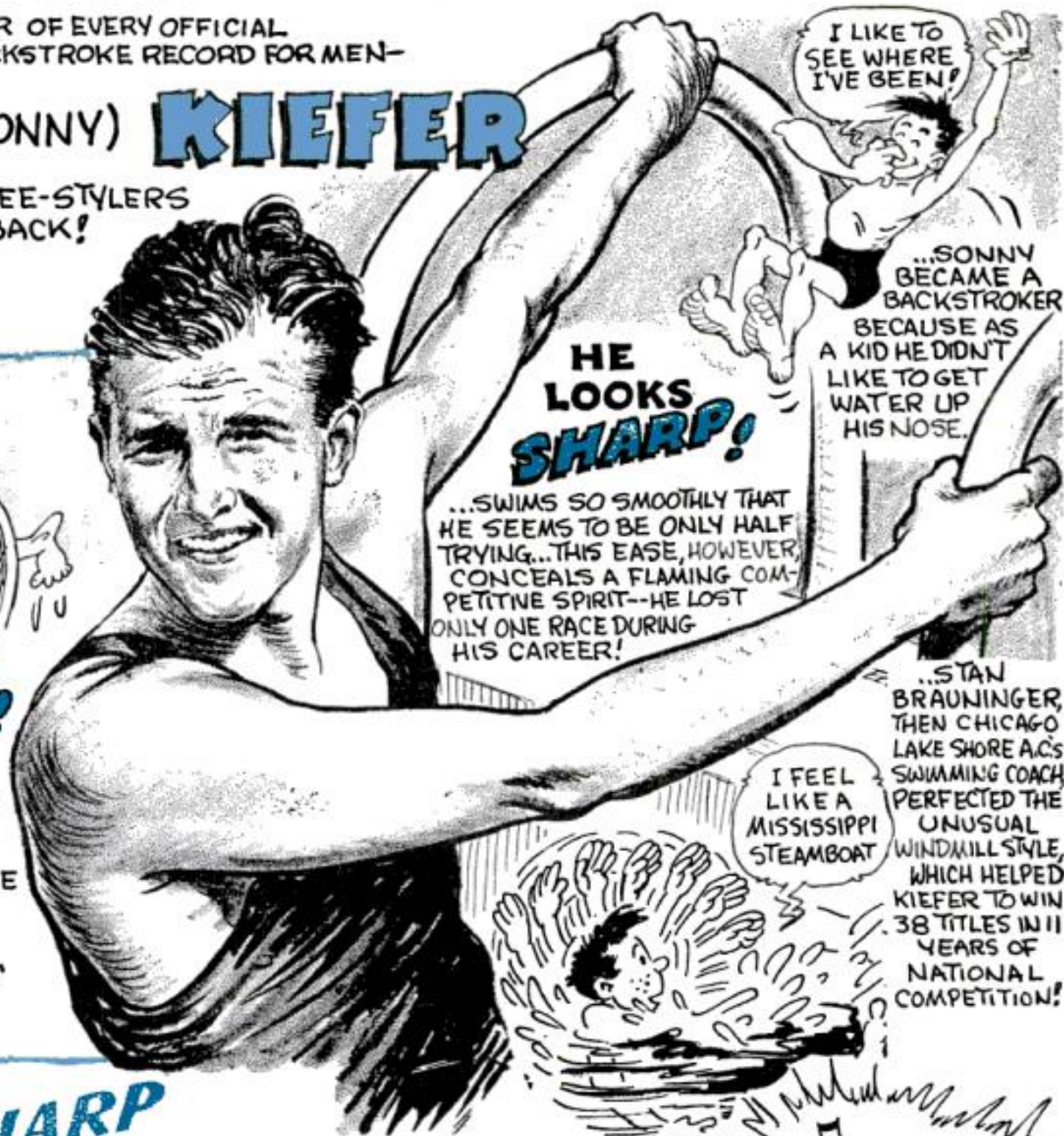
...BEATS MOST FREE-STYLERS  
SWIMMING ON HIS BACK!



NOW YOU'RE  
CATCHING ON!

HE FEELS  
**SHARP!**

YOU'LL ALWAYS  
FIND SONNY IN THE  
"PINK" AS HE  
CARRIES ON HIS  
AMBITIOUS SCHEDULE  
OF LECTURING AND  
COACHING TO  
MAKE AMERICA A  
"SWIMMINGLY SAFE"  
NATION  
!!



HE  
LOOKS  
**SHARP!**

...SWIMS SO SMOOTHLY THAT  
HE SEEMS TO BE ONLY HALF  
TRYING...THIS EASE, HOWEVER,  
CONCEALS A FLAMING COM-  
PETITIVE SPIRIT--HE LOST  
ONLY ONE RACE DURING  
HIS CAREER!

I LIKE TO  
SEE WHERE  
I'VE BEEN!

...SONNY  
BECAME A  
BACKSTROKER  
BECAUSE AS  
A KID HE DIDN'T  
LIKE TO GET  
WATER UP  
HIS NOSE.

...STAN  
BRAUNINGER,  
THEN CHICAGO  
LAKE SHORE A.C.'S  
SWIMMING COACH  
PERFECTED THE  
UNUSUAL  
WINDMILL STYLE,  
WHICH HELPED  
KIEFER TO WIN  
38 TITLES IN 11  
YEARS OF  
NATIONAL  
COMPETITION!

I FEEL  
LIKE A  
MISSISSIPPI  
STEAMBOAT

look **SHARP**  
feel **SHARP**  
be **SHARP**

use  
**Gillette**  
**Blue Blades**  
with the **SHARPEST** edges  
ever honed!



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EVERY FRIDAY NIGHT  
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ALSO AIRS THE ALL-STAR BASEBALL GAME, JULY 8, AND  
OTHER CLASSICS YEAR 'ROUND.

HE IS **SHARP!**

YES SIR, SONNY KIEFER ALWAYS USES  
**GILLETTE BLUE BLADES**  
WITH THE SHARPEST EDGES EVER HONED.  
THAT'S BECAUSE THEY GIVE HIM  
THE SLICKEST, MOST REFRESHING  
SHAVES MONEY CAN BUY.  
ALSO--HE KNOWS THAT  
**DOUBLE EDGES MEAN  
DOUBLE ECONOMY!**

**Gillette Safety Razor Company, Boston 6, Mass.**

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# BRIGHT STAR

## BATTERIES

**GIVE MORE  
BRIGHT LIGHT  
LONGER  
FOR YOUR 10¢**



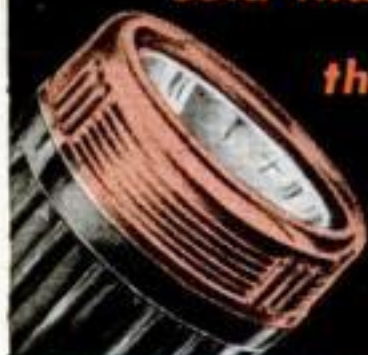
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UNDER GOVERNMENT STANDARDS**

THREE LEADING BRANDS TESTED	BRIGHT STAR	BATTERY A	BATTERY B
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<b>GOOD LIGHT</b>			
<b>FAIR LIGHT</b>			

Each column adds up to 10 cents, but **BRIGHT STAR** leads the field with **70% VERY BRIGHT LIGHT**.

And that's not all... Bright Star batteries give **150%** of the Light Industrial Test requirements as specified by the U. S. Gov't Bureau of Standards.

*... and there are more  
BRIGHT STAR FLASHLIGHTS  
sold than any other make.  
they, too, have been  
best since 1909!*



BRIGHT STAR BATTERY CO.  
CLIFTON, N. J.




## Plastic Tray Is Easy to Carry

THIS lucite serving tray saves steps for the hostess and minimizes the possibility of upsetting or breaking glasses. Made by the Miracle Patent Co., of Hollywood, Calif., the Sway Tray has a 10- or 12-inch-diameter surface. A knob, joined to the handle by a flexible cord, makes it possible to carry the tray easily with one hand.

## Chemical Sticks Help Remove Stains from Fabrics

STUBBORN stains caused by tea, coffee, ink and other substances can be removed from clothing by using two waxlike, chemical sticks. The soiled fabric is laid over a clean undercloth and sponged, and an acidic stick is daubed into it until the undercloth shows no more stain. After the stained area has been sponged again, a reducing stick is rubbed on to remove the spot completely. The stain remover was developed by Carbide and Carbon Chemicals Corp.



### Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as regular Champions. Sillment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One piece construction.

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Dependable

# CHAMPION

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Lakes," owned by Al Fallon of Detroit, which was driven by Dan Foster at record-breaking speeds to win all three heats in the President's Cup Race. Champion is America's Favorite Spark Plug, on land, water or in the air, because it is always dependable for every engine. Champion Spark Plug Company, Toledo 1, Ohio.

**FOLLOW THE EXPERTS**—DEMAND DEPENDABLE CHAMPIONS FOR YOUR CAR

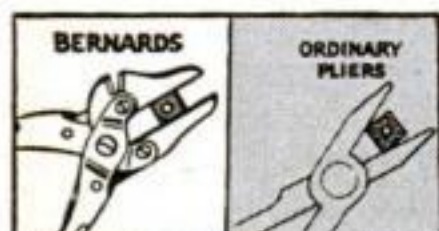
Listen to the CHAMPION ROLL CALL, Harry Wismer's fast sportscast every Friday night, 9:55 EDST over the ABC network

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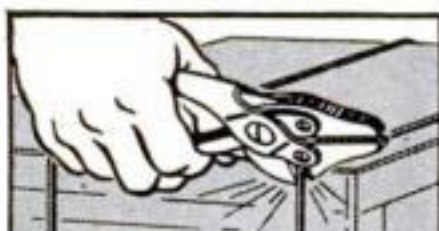




There's no other pair of pliers in the world like the Parallel-Action BERNARD. And here's why they're so handy for you.



Jaws close parallel—like a vise. Fit snug and flat. Won't slip or mar the nut.



Powerful cutters on the outside of the head, easy and convenient to use. They'll cut an 8-penny nail!

Hundreds of thousands of BERNARD's went to war in Yank machine gun kits, but, once again, they're available to you at your local hardware store.

**Look for the name "BERNARD"**  
BERNARD Parallel-Action PLIERS are one item in a line of fine hand tools—hedge clippers, pruners, paper and leather punches, etc.—known for quality for 75 years. *Free catalog on request.*

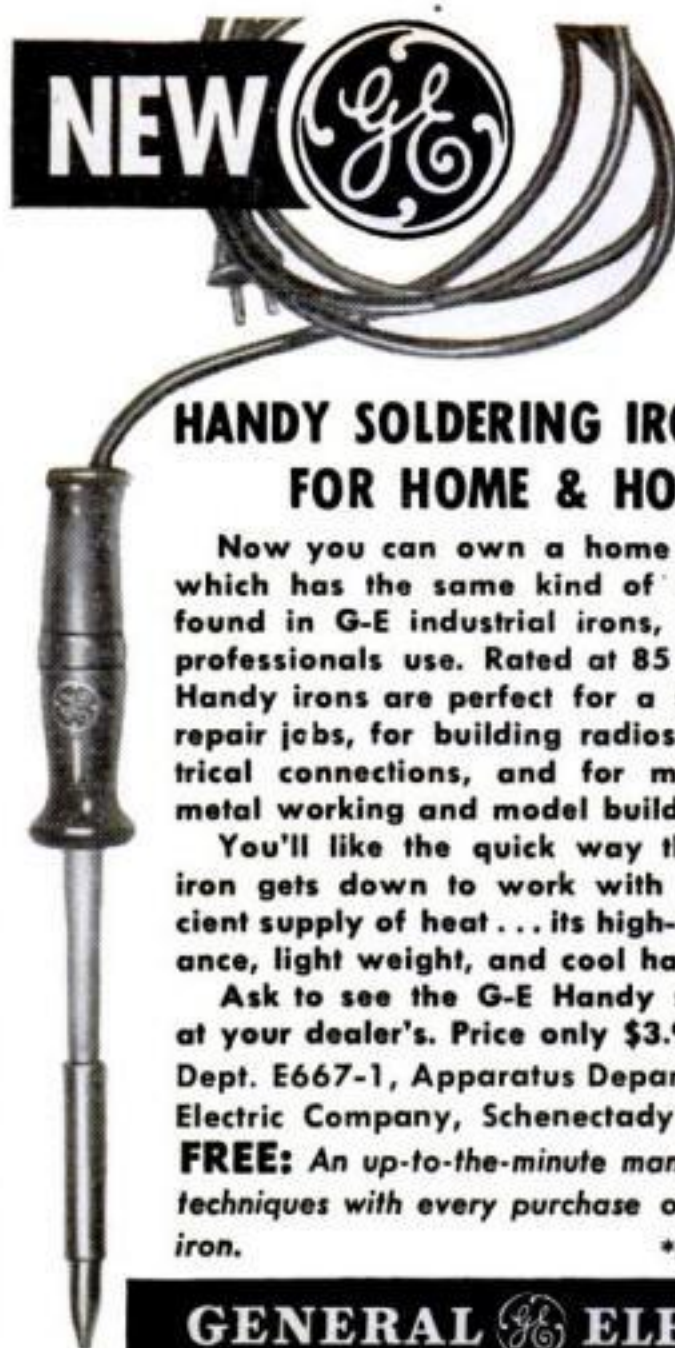
QUALITY

TOOLS SINCE 1870

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TRADE MARK REGISTERED

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7006 Chapel Street, New Haven 9, Conn.

236 POPULAR SCIENCE



## HANDY SOLDERING IRON FOR HOME & HOBBY SHOP

Now you can own a home soldering iron which has the same kind of Calrod\* heater found in G-E industrial irons, the irons that professionals use. Rated at 85 W, 115 V, G-E Handy irons are perfect for a score of home repair jobs, for building radios, making electrical connections, and for many kinds of metal working and model building.

You'll like the quick way this G-E Handy iron gets down to work with a steady, efficient supply of heat... its high-speed performance, light weight, and cool handle.

Ask to see the G-E Handy soldering irons at your dealer's. Price only \$3.95. Or write to Dept. E667-1, Apparatus Department, General Electric Company, Schenectady 5, N. Y.

**FREE:** An up-to-the-minute manual on soldering techniques with every purchase of a G-E Handy iron.

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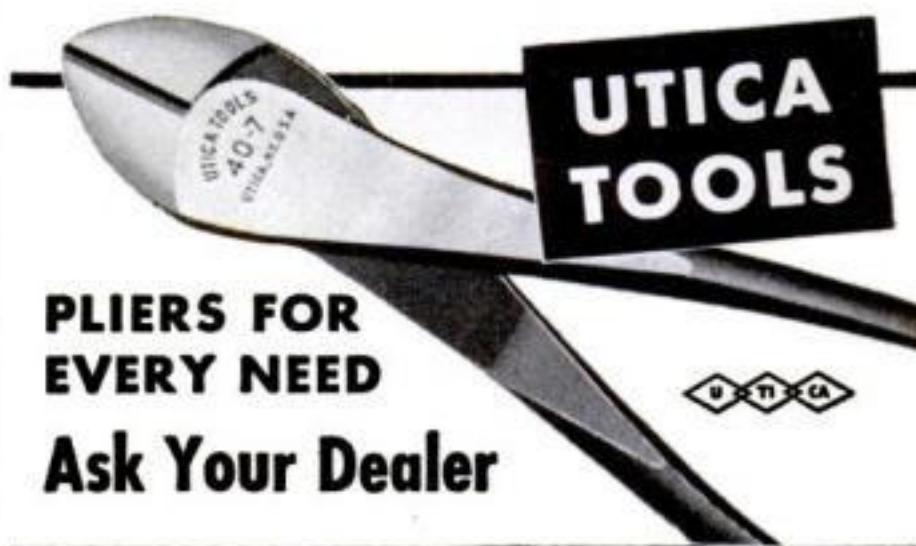
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**PLAN SET No. 14**

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Drawings fully detailed, step by step. Send for Set No. 19 and free list of Plan Sets. **STANLEY TOOLS**, 267 Elm St., New Britain, Conn.



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EVERY NEED**  
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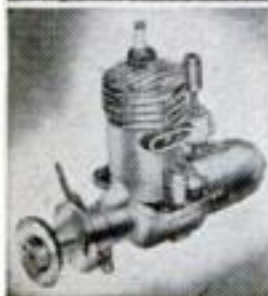
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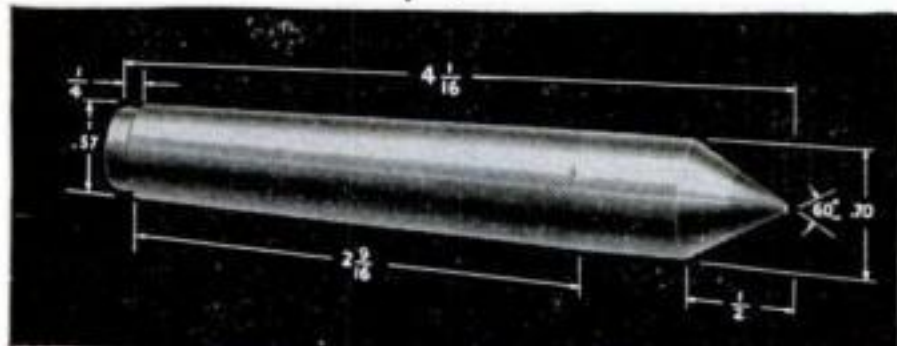
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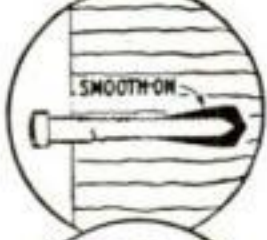
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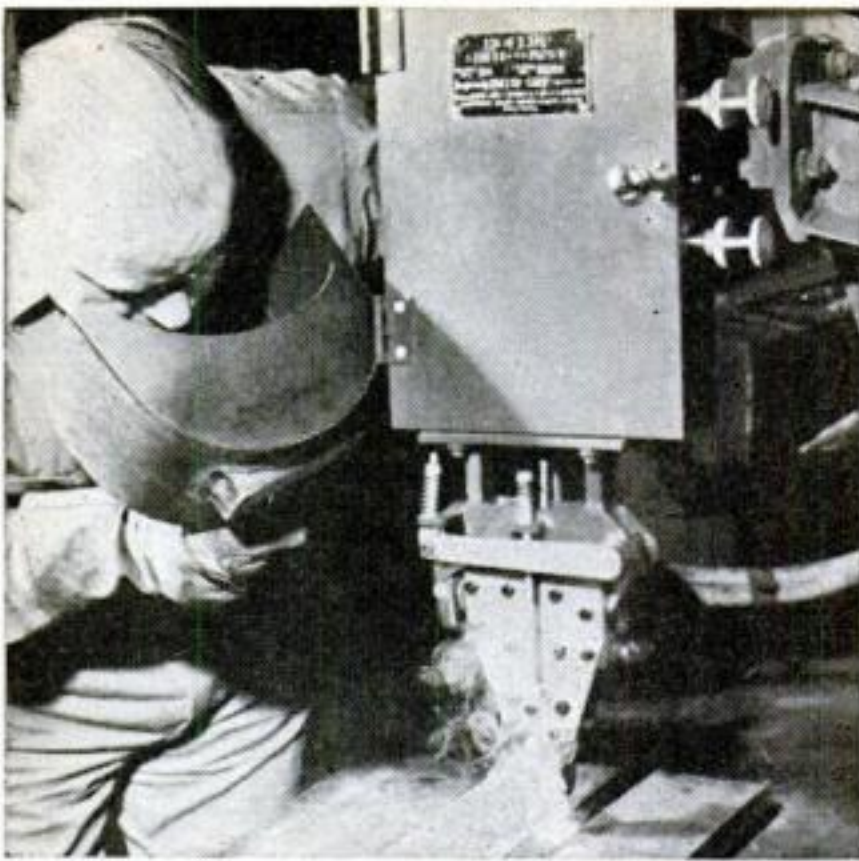
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## Welding Electrode Improved

A NEW automatic welding electrode, which can be bent or twisted without loss of its flux coating, has been developed by the Hollup Corp. Because metallic parts and flux are combined (Fig. 1, in diagram) to produce a crucible-enclosed arc, flare is reduced (as demonstrated above, left), and



FIGURE 1

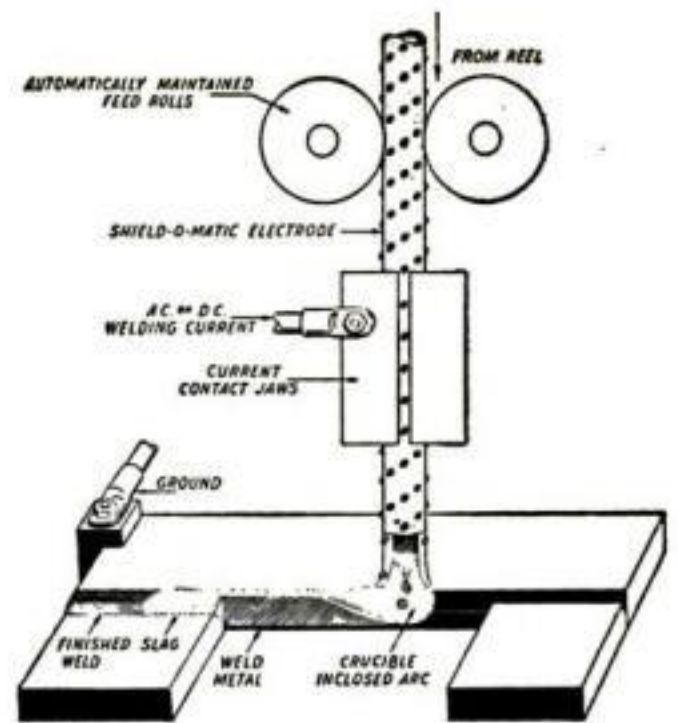


FIGURE 2

more uniform welds are possible. Fed continuously from a reel (Fig. 2), the Shield-O-Matic electrode also permits conduction of unusually high currents, causing faster fusion with base metal. Slag, caused by flux not converted into vapor, settles on the welded metal and slows cooling long enough to allow impurities to float to the surface, where they are then absorbed by the slag.

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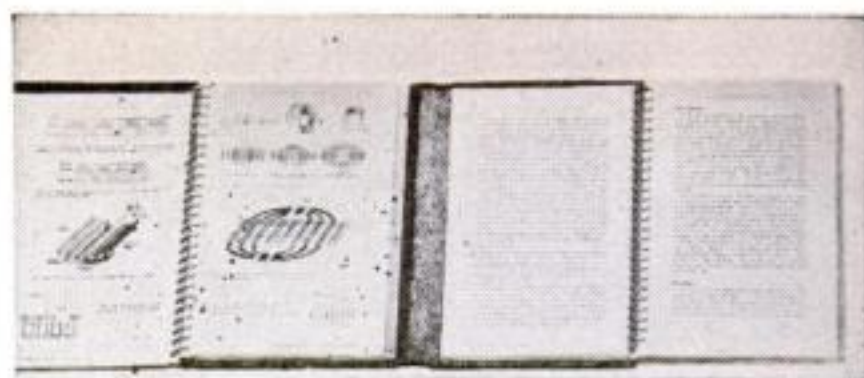


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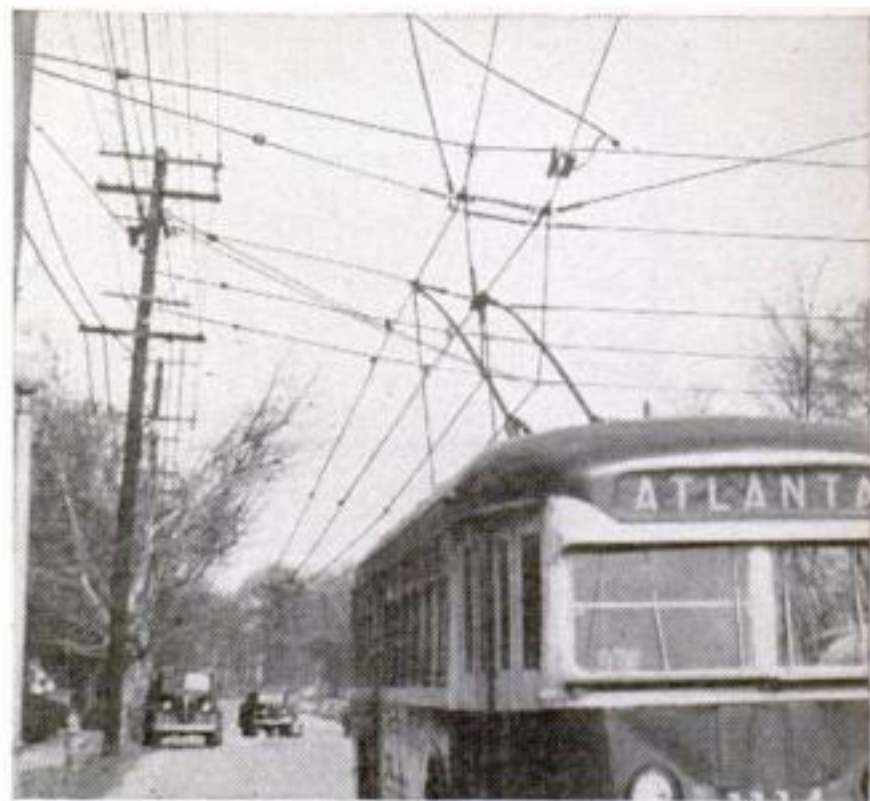


## Book Binding Simplifies Use



DESIGNED as a working guide for students and mechanics, a new manual entitled "Electric Motor Repair," by Robert Rosenberg, has a binding as practical as its contents. Published by Rinehart & Co., a two-section arrangement permits the text and related illustrations to be brought together (top picture)

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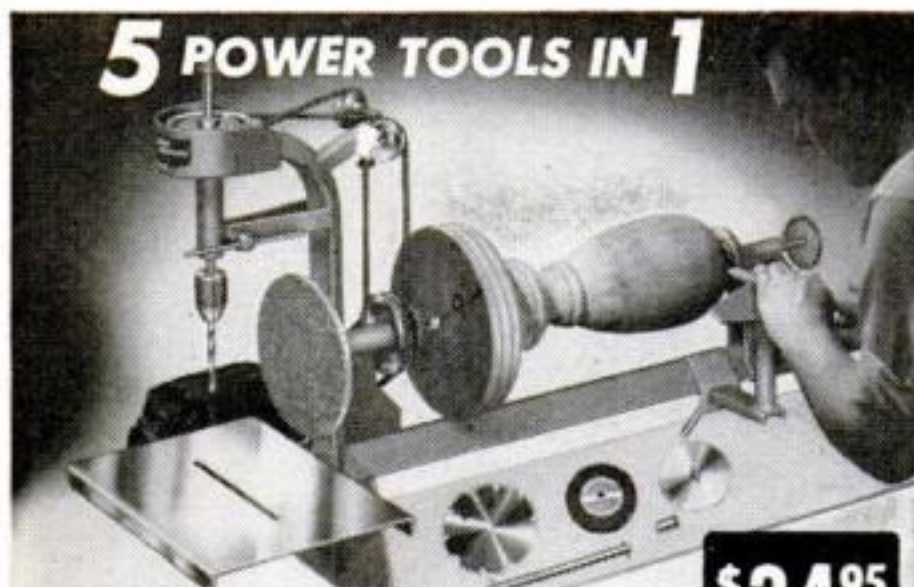
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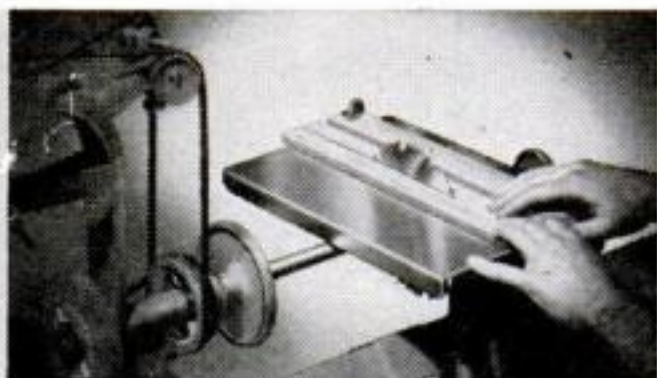


**LATHE** 10" swing, 30" between centers,  $\frac{3}{4}$ " spindle, face plate, spur center, tool rest.

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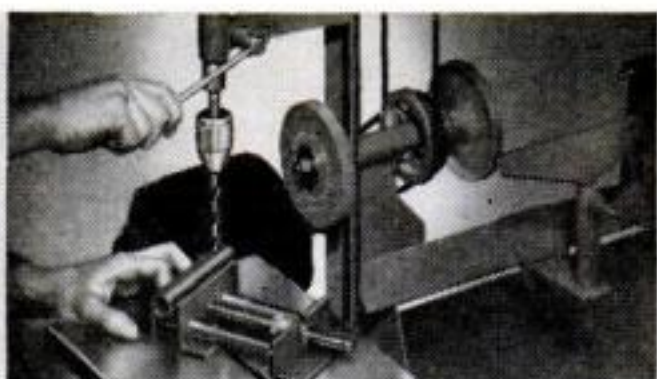
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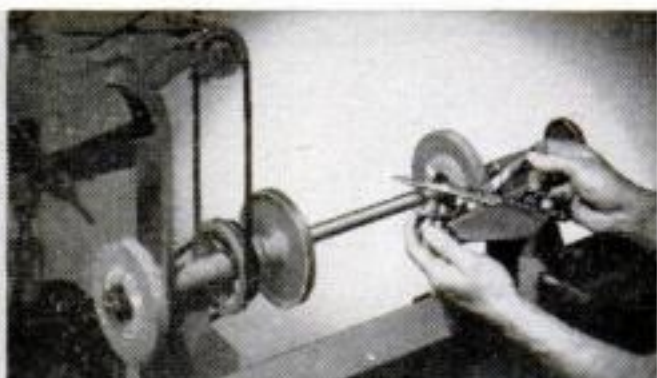
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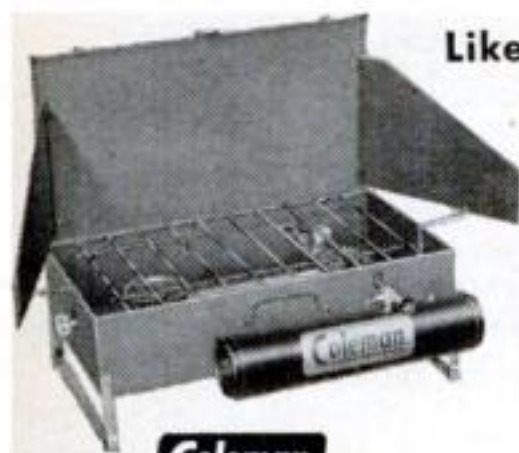
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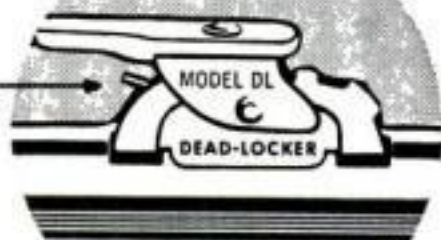
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• No, Burd doesn't advocate breaking speed-laws, but you don't have to confess that the old bus hasn't the pick-up she used to have. Install Burd "Graf-Flox" Piston Rings, and "hang onto your hat!" No kidding, the right Burd Combination Set in your engine will really work wonders . . . will give it surprising new power and snap . . . will cut fuel and oil bills. Yes, you'll get new-found pleasure in driving. Ask your service man about Burd Piston Rings . . . they are "Engineered for Results." Two free booklets, packed with handy information for the car-owner, are available free. Mail the coupon tonight!

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I'd like copies of your "Servicemen's Handy Handbook," which tells how to keep my car in good working order, and the booklet "No Job For A Dub."

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*by don herold*



At our house, I'm it. But I'm bright enough to know when I've finally found the way to plug holes and cracks!

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CORDS A DAY—  
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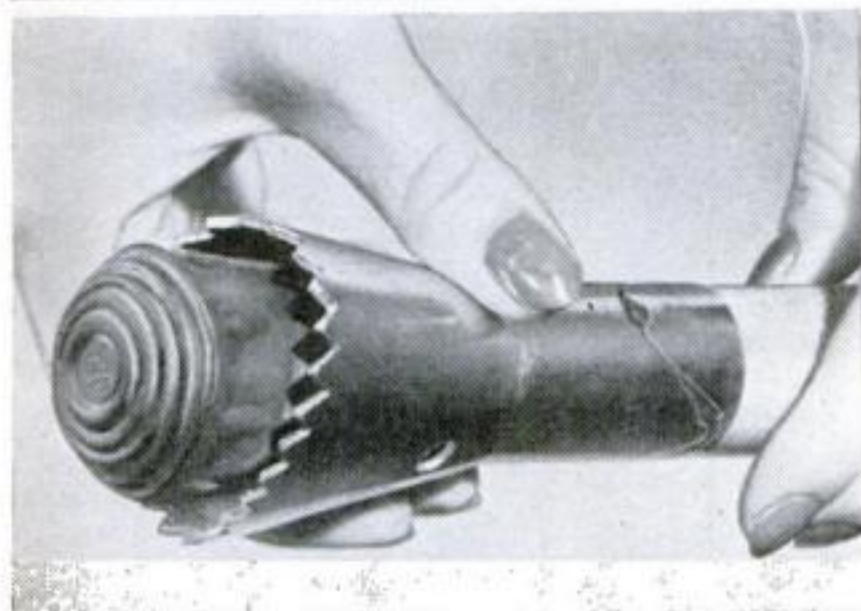
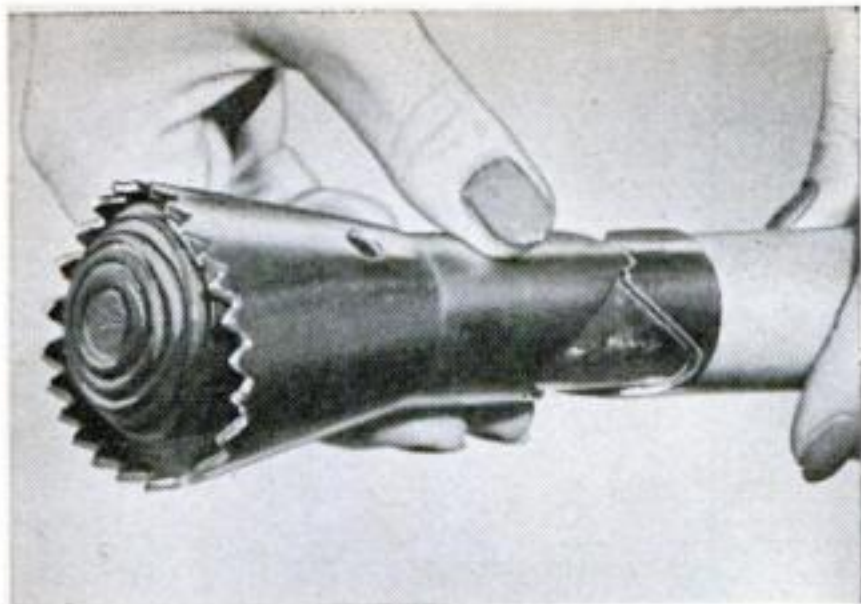
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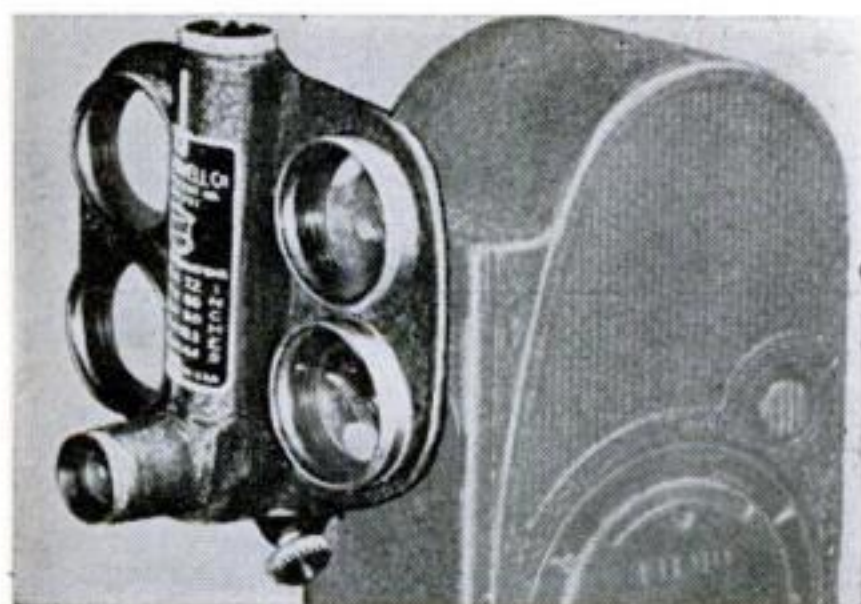






## Steel Tip Steadies Crutch

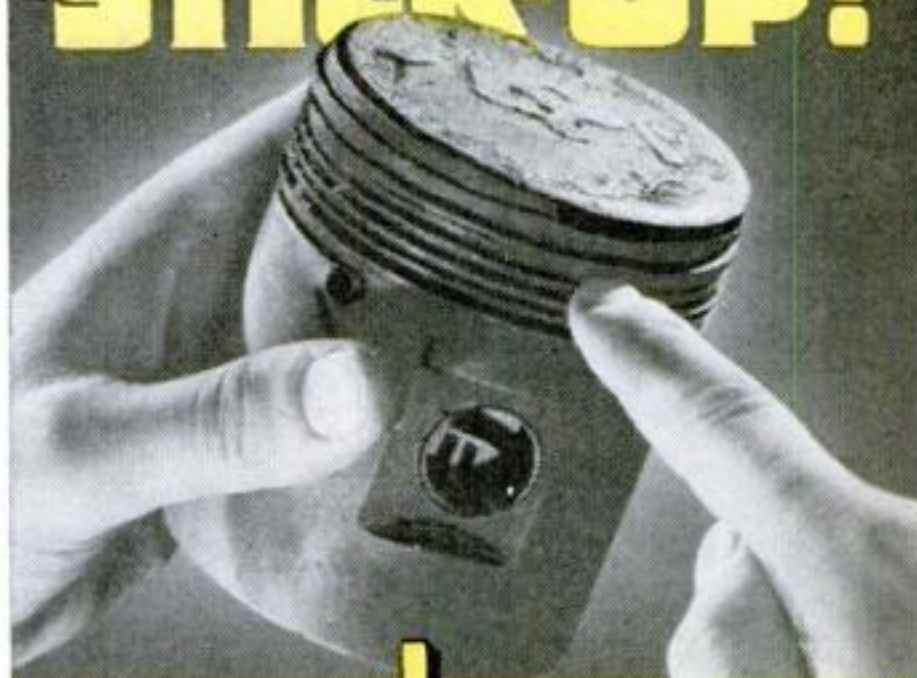
DESIGNED to grip firmly on packed snow, wet pavements and other slippery surfaces, a steel safety tip for crutches is easily attached. A quarter turn adjusts it for use or retracts it. Peck Industries, of Cleveland, makes the device.



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SHARP focusing at ranges as close as six inches is possible with a Bell & Howell attachment for users of Filmo eight- and 16-mm. movie cameras. An auxiliary lens with compensating view finder comes with the new unit.

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It's a "stick-up"—and you're the loser—when dirty oil circulates through your engine. Have your oil tested—*free*—by the AC method. If your oil contains grit, dirt or carbon, it stands out clearly on the clean white AC Test Pad.

Dirty oil clogs piston rings and slots—makes valves stick—wears out moving parts—wastes fuel and oil—robs engines of power.

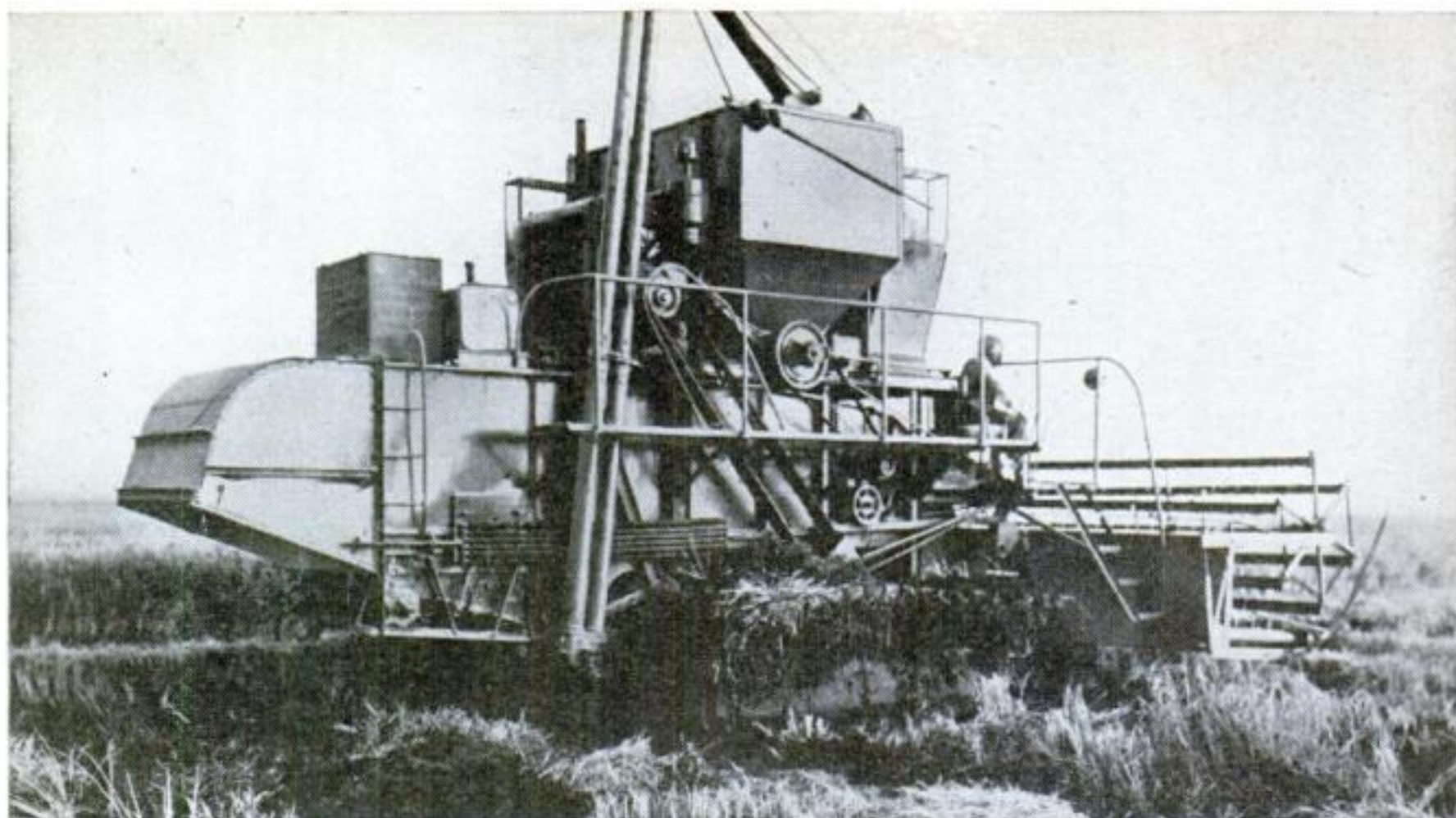
You can prevent that "highway robbery" by installing an AC Oil Filter or Element. Why not do it today?

Free oil tests with AC Test Pads, as well as AC Oil Filters and Elements, are available at any AC Oil Filter Service Station.



AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION





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HIGH-POWER RIFLES



MARLIN 36 CARBINE  
Barrel Length 20"

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Barrel Length 20"

MARLIN 36-A RIFLE  
Barrel Length 24"

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252 POPULAR SCIENCE

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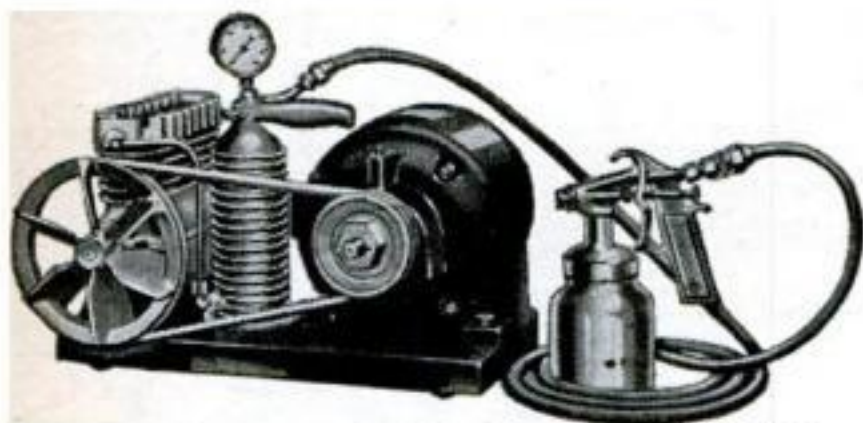


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KAMPKOLD**



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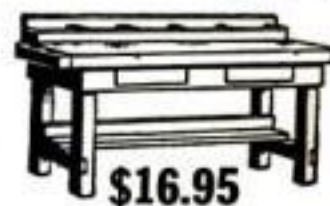
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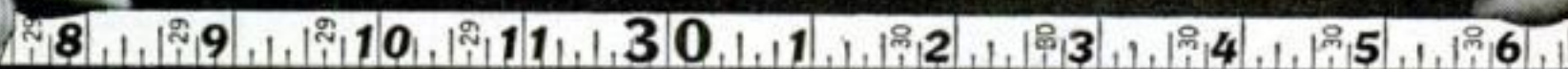
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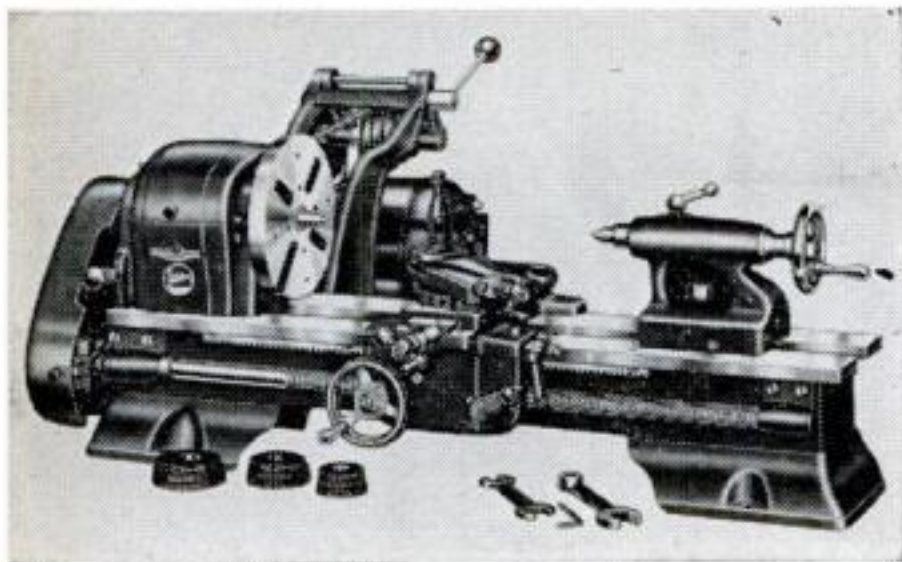
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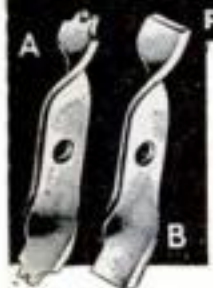


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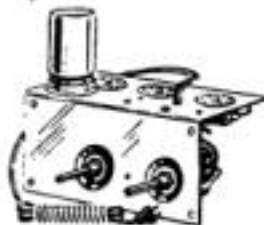
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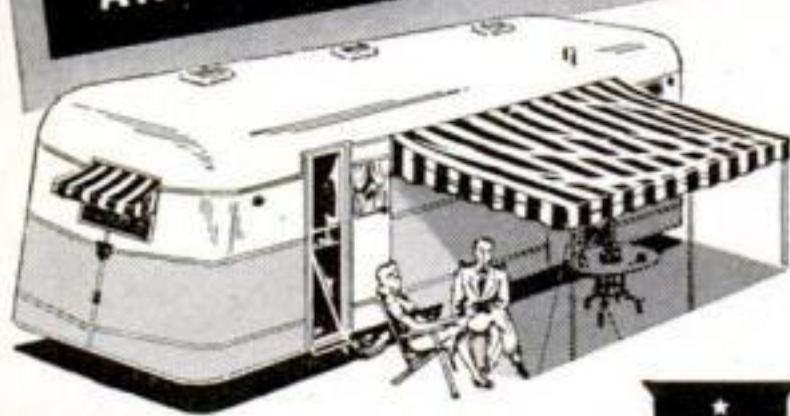
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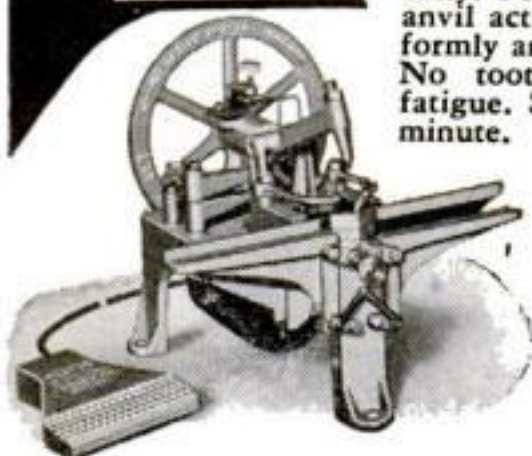
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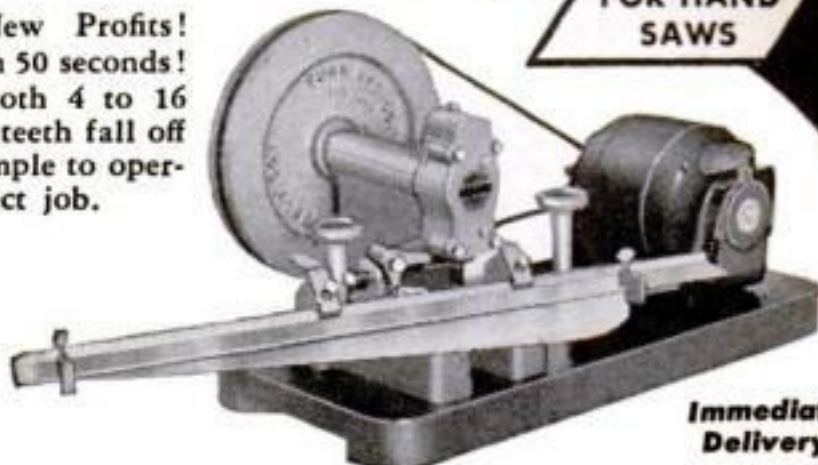
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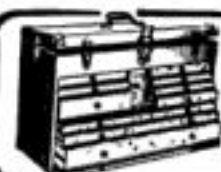


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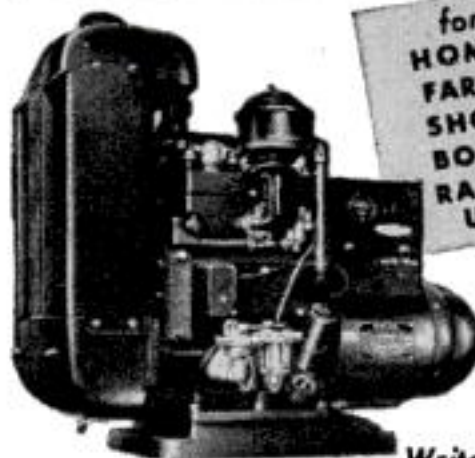
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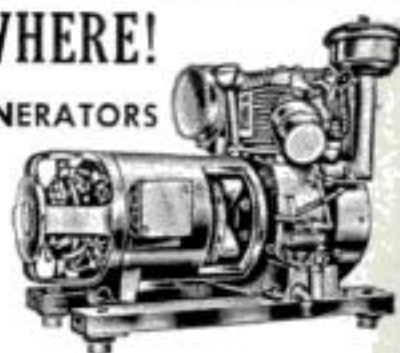
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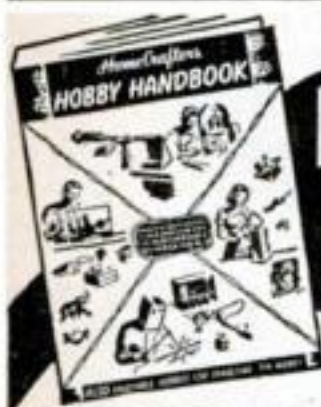


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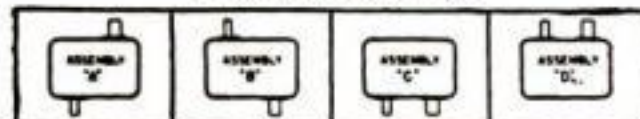
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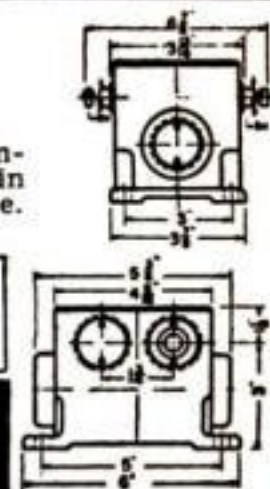
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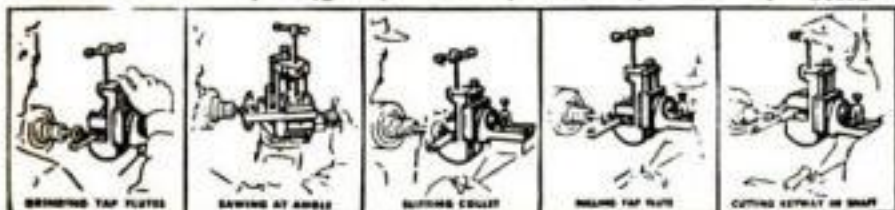
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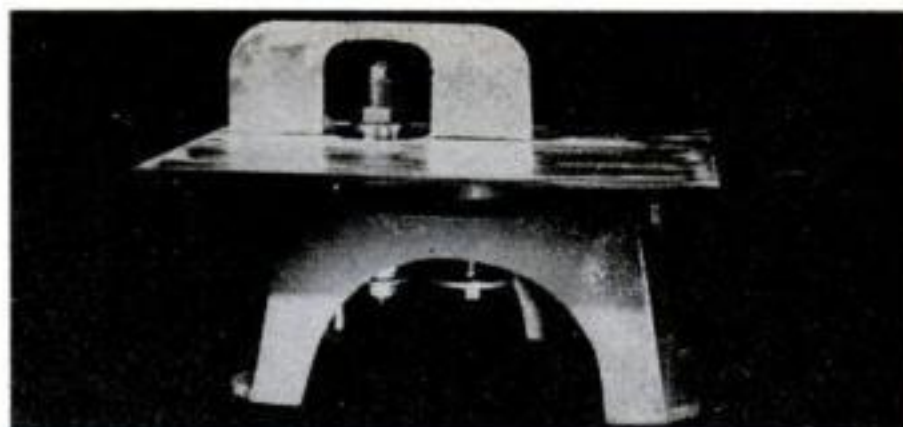
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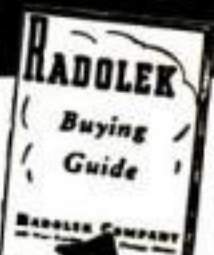
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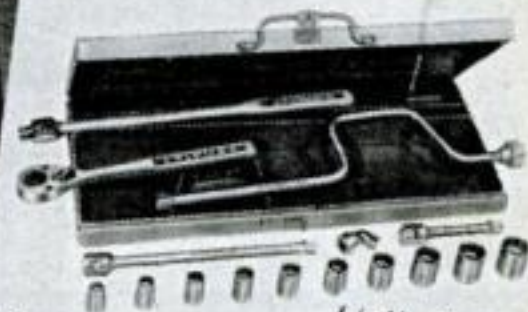
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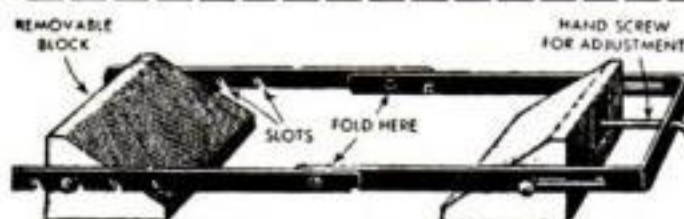
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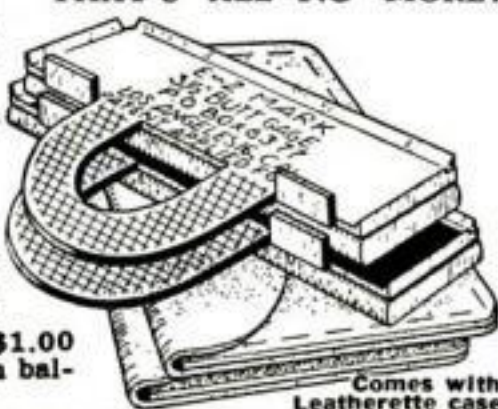
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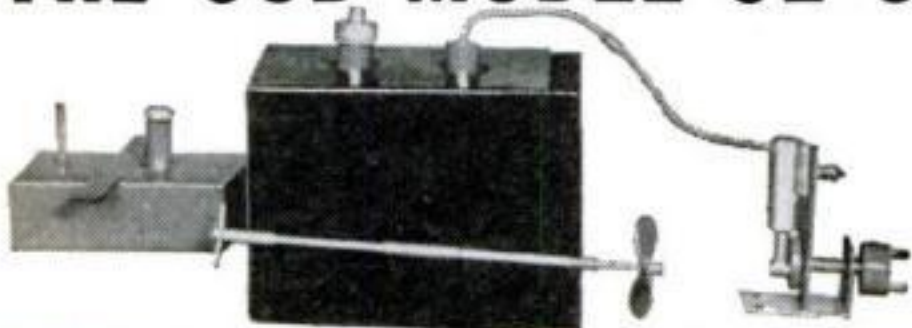
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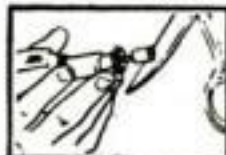
**GRINDING**



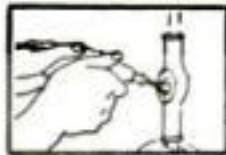
**DRILLING**



**ENGRAVING**



**SHARPENING**



**CLEANING**

Real  
fractional  
horsepower  
AC-DC  
Electric  
Motor



## FAMOUS CASCO POWER WORKSHOP

*New portable all-purpose Electr-O-Tool Kit*

**FOR MECHANICS,  
HOBBYISTS, HOME CRAFTSMEN**

Speed your work on wood, metal, glass, plastics, leather with this professional all-purpose tool. More exclusive features than any other tool on the market. Long life, powerful 20,000 RPM motor in unbreakable plastic case, oilless bearings, air-cooled. Exclusive built-in finger grip for perfect control in fine detail work. Weighs only 12 1/2 oz. Fully guaranteed. Complete with 20 precision-made accessories in fitted chest. Hobby or professional work is easier with this whole shop full of tools in one. Do hundreds of jobs by simply changing the versatile accessories.

Buy at your dealer's today. If he cannot supply, write direct to factory giving dealer's name. *Free descriptive literature on request.*

### SPECIAL LOW PRICE OFFER

Price of power tool alone . . . . .	\$14.95
20 accessories and valuable Project Book . . . . .	8.50
<b>Total Value . . . . .</b>	<b>\$23.45</b>

**ALL 21 PIECES FOR ONLY \$14.95**



**• ANOTHER  
BIG VALUE!  
CASCO  
ELECTRI-CRAFT  
POWER TOOL KIT**  
complete with  
36 accessories in  
fitted steel chest  
**\$32.95 value  
for only \$22.50**

# CASCO

**CASCO PRODUCTS CORPORATION • BRIDGEPORT 2, CONN.**

JUNE 1947 269



TO:

Reader

FROM:

Editor

## In PSM's WORD SHOP

**W**HERE is Lac Seul? In what year was the cathode-ray tube discovered? Do you spell the U-boat breather tube Shnorkel, Snorkel, or Schnorkel? Paraphrase "registry of noncyclic motion" so that the nontechnical reader can understand it.

No, this isn't the script for Information Please. It is just part of the daily budget of questions that PSM's copy room must answer promptly—and accurately.

You probably never heard of a copy room. Most people haven't. Its inhabitants, who are called copyreaders, are used to being confused with (a) proofreaders, who wear



**JOHN F. STEARNS** comes from a whole family of writers and editors, and for the last 14 years he's been wavering between the two professions. As head of PSM's copy desk he makes full use of experience gleaned on newspapers, on magazines, and as a free-

lance. The AAF tried for a year to make him a radio operator, then made him copy chief of the Office of Flying Safety. His two chief hobbies: studying the machinery of aviation, and tinkering with radio sets.

long green eyeshades and live in printing shops, and (b) copywriters, who wear hand-painted neckties and frequent advertising agencies. Copyreaders are a different breed. Their job is to take a long look at everything that goes into PSM and see that it is complete, correct, comprehensible—and at the printer's on time.

Take the problem of fitting to space. PSM, as you know, is one of the few magazines that don't make you grope for carry-overs. But this means that every piece has to fit to the last word. To trim an article so as to save style, sense and space is an art. The copyreader finds himself looking for a four-letter synonym for phenomenologist to squeeze in that last line.

Then there are deadlines—the copy-reader's sword of Damocles, ready to drop on his head at any moment. PSM has three major deadlines a month—and then the copy room is even more harassed than



**CAROL ENNIS**, young as she is, is the veteran of the copy room, having mastered the idiosyncrasies of four chiefs. She carries in her head the Chinese puzzle of PSM's production schedule—involving engravers, two printers, first form, second form, roto section, first and second proofs, foundries and red prints. She takes evening courses in editing at Columbia, ran a club newspaper for servicemen during the war.

usual. Author Doakes wants two more days to polish his article. A layout isn't ready at the last minute for lack of a special cutaway. A professor, checking a piece, changes one little sentence—which means resetting two pages—and the printer is already screaming . . . See what I mean?

Editors can dream of speaking to millions of readers; writers are wrapt in their beautiful prose, but the copyreaders are face to face with reality: Is there or is there not going



**SHELDON M. GALLAGHER** is the latest recruit to PSM's copy room, coming straight from Antioch College. Through the Antioch system of alternate work and study, however, he has already had considerable experience. His major interest is the philosophical implications of science; his major worry at the moment is struggling with the popular items "I'd Like to See Them Make" and "New Ideas from the Inventors."

to be a magazine on the stands next month?

Like the President's assistants, copyreaders are supposed to be people with a passion for anonymity. But, even if you don't know they're there, you'd miss them if they weren't. Which is why you'll find three of them on this page today.

*Hartley E. Howe*



This One



WAKY-8SF-2LWL





## **My dentist looked down in the mouth!**

I see my dentist twice a year, regular. But does he see me—his Doctor of Motors—regular? He does not!

"Look," I told him a few days ago, "cars, like teeth, need good care. You expect good service from your car every day, yet you never think to take care of it."

Boy, he certainly looked down in the mouth. But after I had ground the valves and put in new gaskets and a set of Perfect Circle Piston Rings, she stopped pumping oil, gave him more power and

drove like a dream. He was one happy Doc as he drove away.

A Doctor of Motors, like a dentist, can spot trouble before it happens and keep little troubles from becoming big ones. Just that regular care can save plenty in worry and money.

### **NOTICE TO CAR OWNERS**

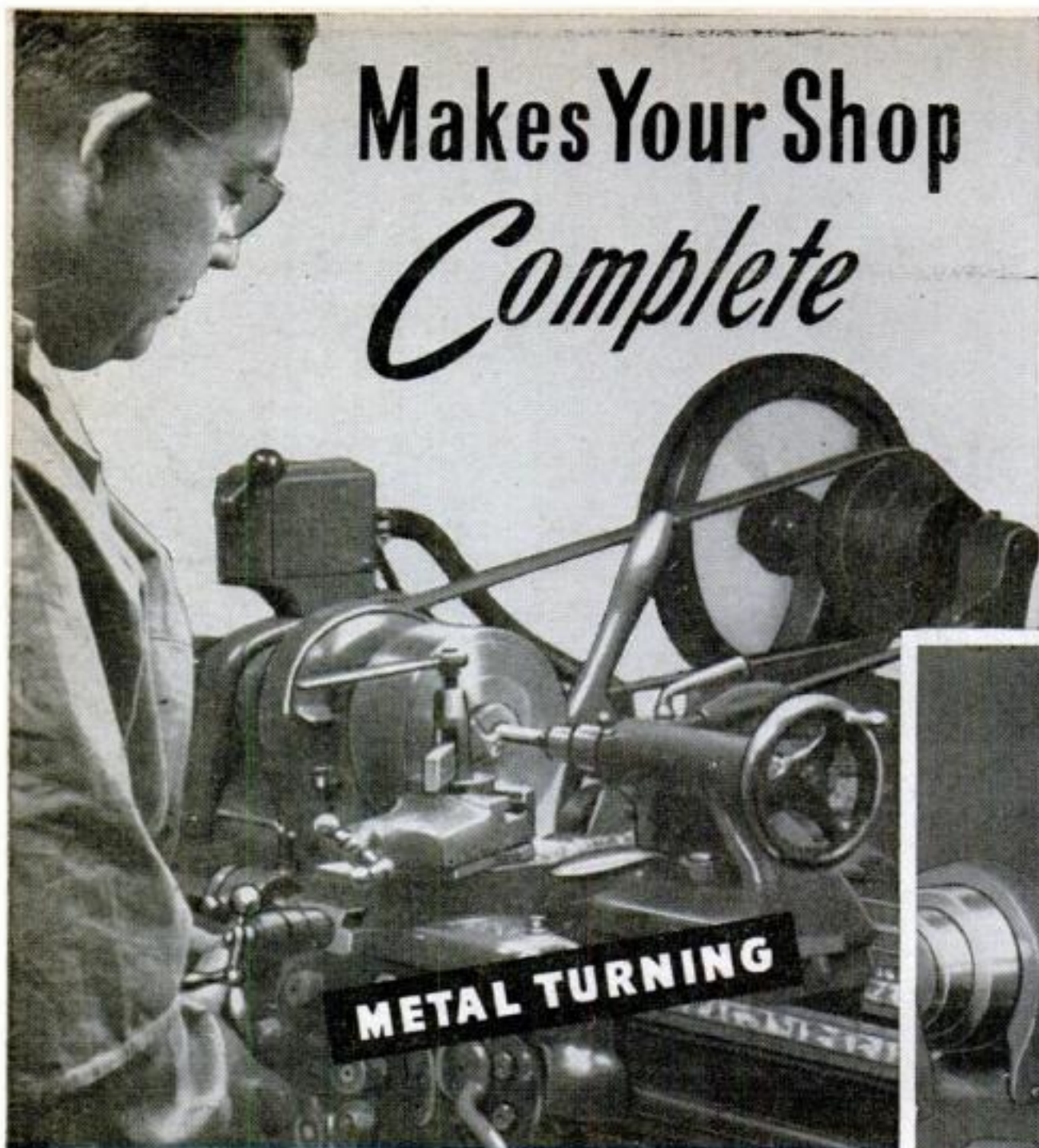
Perfect Circles are available at any automotive repair shop. Your favorite mechanic—your Doctor of Motors—recommends them.

PERFECT CIRCLE CORPORATION, HAGERSTOWN, IND., U. S. A. and TORONTO, ONT., CAN.

Your Doctor of Motors  
restores power . . . saves gas  
. . . saves oil with . . .

**PERFECT  
CIRCLE** **PISTON  
RINGS**

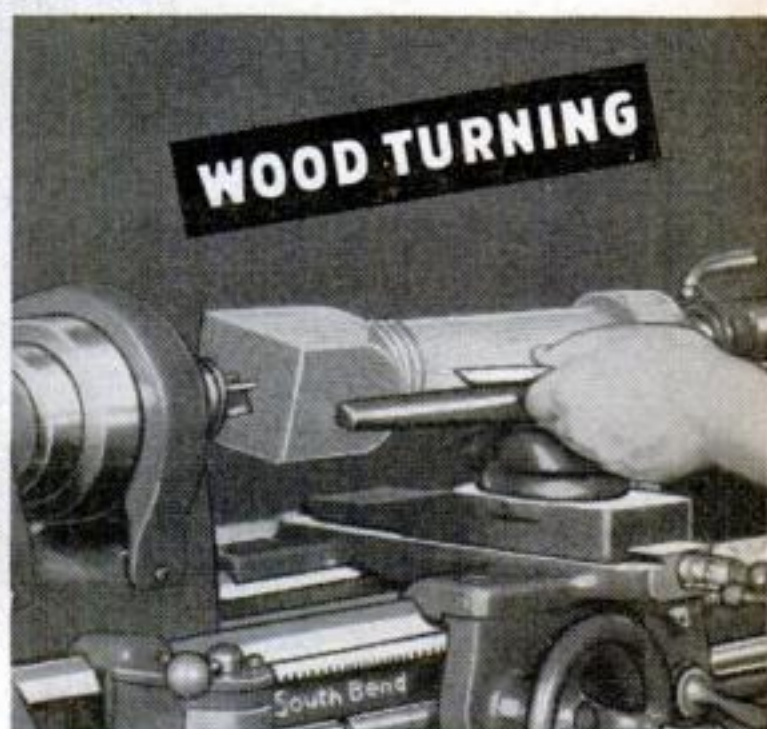




Makes Your Shop  
*Complete*

**SOUTH  
BEND**

**The Multi-Purpose  
Lathe**



You get more enjoyment and use out of your shop when you have a South Bend Lathe. It opens up new fields for you—new hobbies, new projects and a diversification of work that is both interesting and profitable.

This better metal working lathe reduces to a minimum your investment in basic shop equipment—its ruggedness and built-in accuracy will help you to turn out better work. And available attachments and accessories make possible the performance of many operations ordinarily done on other machines. Mail coupon for catalog.

**South Bend Lathe Works**  
**456 E. Madison Street, South Bend 22, Indiana**

Please send latest South Bend Lathe catalog.

Size lathe in which I am interested is \_\_\_\_\_

Name \_\_\_\_\_

Street \_\_\_\_\_

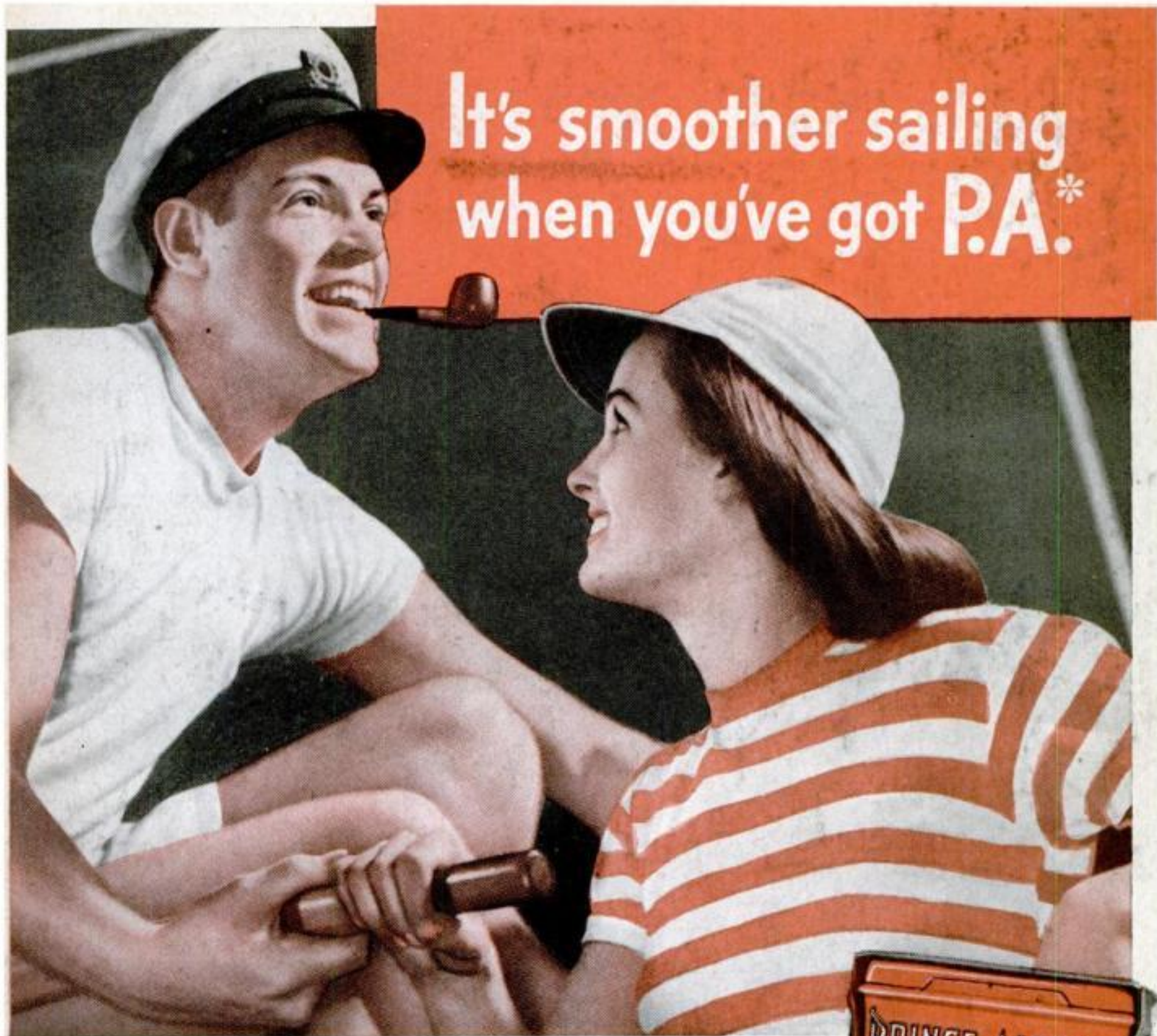
City \_\_\_\_\_ State \_\_\_\_\_

**SOUTH BEND  
LATHE WORKS**



BUILDING BETTER LATHES  
SINCE 1906





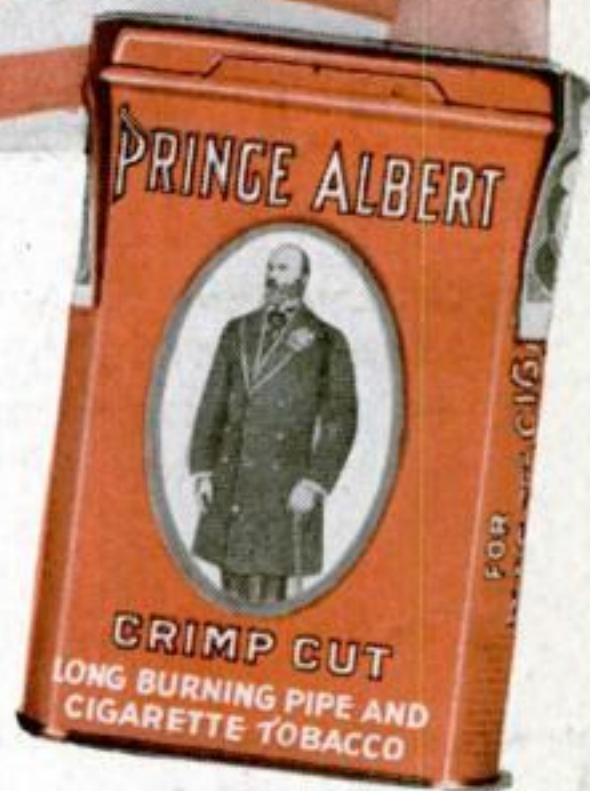
It's smoother sailing  
when you've got P.A.\*

**P.A.\*** means **P**ipe **A**ppeal  
When a man smokes a pipe, he has a masculine attractiveness that women find appealing! And, when he smokes Prince Albert, he has a rich-tasting smoke that's easy on the tongue!

**P.A.\*** means **P**rince **A**lbert

Try Prince Albert and you'll agree—it's a great tobacco! P.A. is *crimp cut*—packs and cakes just right in your pipe . . . smokes cool and even right down to the bottom of the bowl.

R. J. Reynolds Tobacco Co., Winston-Salem, N. C.



**The National Joy Smoke**

A GREAT CIGARETTE TOBACCO TOO.  
NOTHING LIKE P.A. FOR FAST, EASY  
ROLLING AND TASTY SMOKING!





**EXPERIENCE IS THE  
BEST TEACHER!**

Simple dives...intricate spins — Mildred O'Donnell mastered them all to win New York's Metropolitan diving championship.

IT'S TRUE IN DIVING...  
**EXPERIENCE IS  
THE BEST TEACHER!**  
...AND IN SMOKING TOO.  
THE CIGARETTE FOR ME  
IS **CAMEL!**

*Mildred  
O'Donnell*

DIVING CHAMPION

**More people are smoking CAMELS than ever before in history!**

Yes, experience during the shortage taught millions  
the differences in cigarette quality!

**YOUR 'T-ZONE'  
WILL TELL YOU...**

**T** for Taste...  
**T** for Throat...

That's your proving ground for any  
cigarette. See if Camels don't  
suit your 'T-Zone' to a **T**!

**D**IVING Champion Mildred  
O'Donnell hasn't forgotten  
the war shortage of cigarettes.

"I never realized there were  
such differences in cigarettes  
until the shortage," she recalls.  
"That's when I really learned  
what cigarette suits me best —  
Camel."

Millions of others had the  
same experience, with the result  
that *today more Camels  
are being smoked than  
ever before in history.*

**IT WAS NO FUN**, the  
cigarette shortage;  
but it was a real ex-  
perience.

R. J. Reynolds Tob. Co., Winston-Salem, N. C.

According to a recent Nationwide survey:

**MORE DOCTORS SMOKE CAMELS**  
than any other cigarette

Three nationally known independent research organiza-  
tions asked 113,597 doctors to name the cigarette they  
smoked. *More doctors named Camel than any other brand.*